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VOL. CLIII.—No. 3965] LONDON: FRIDAY EVENING, JANUARY 8, 1932 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

Army Contracts.

Notice is hereby given that TENDERS for QUANTITIES of the undermentioned MANUFACTURED GOODS are INVITED from time to time, as required :—

METAL TRADES :—

Aluminium Ingot and Castings, Brass, Brass Rod and Sheet, Bronze Stampings, Copper Ingot and Sheet, Lead, Pig and Sheet, Metal Rod, Nickel, Pig Iron, Steel Plate, Rounds, Sheets, &c. Shell Steel, Tin Ingot, Tin-plates, Tinned Brass Pressings and Stampings, Zinc Ingot and Sheets.

Baths, Bicycles, Building Materials and Fitments, Cutlery (including Safety Razors and Blades), Enamelled Ware, Hollow-ware, Horseshoes, Ironmongery, Machinery, Pipes, Steel and Cast Iron, Stable Fitments, Stoves and Ovens, Tinware (including Canisters, &c., to precise dimensions), Tools, Vehicles, Wire, Wire Rope.

ELECTRICAL AND SCIENTIFIC INSTRUMENT TRADES :—

Cables, Electrical Plant, Electrical and Wireless Stores, Scientific Instruments.

TEXTILE TRADES :—

Blankets and Rugs, Braid and Lace, Canvas and Canvas Goods, Clothing (made up from Department's own Materials), Cotton Piece Goods and Cotton Goods, Cordage, Flannel (Union), Headdresses, Horse Rugs, Hosiery, Linen Piece Goods, Silk Cloth and Webbing and Sewing Silk, Towels, Woollen Cloths.

FOODSTUFFS, COAL AND COKE.

OTHER TRADES :—

Badges and Buttons, Basket-ware, Bedding, Boots and Shoes, Brooms and Brushes, Chemicals and Gases, China and Earthenware, Furniture, Glazed Ware Drain Pipes, Harness and Saddlery, Leather and Leather Goods, Linoleum, Medical Supplies, Moulded Rubber Articles, Oil-dressed Clothing, Oils and Spirits, Paints and Varnishes, Rubber Boots and Clothing, Safety Glass, Sanitary Appliances, Timber, Woodware.

Manufacturers who are not already on the War Office List of Tenderers, and who may wish to be invited to Tender for Army requirements of the above stores, should apply to the Director of Army Contracts at the address given below for Form 1, on which formal application for inclusion on the List of Tenderers may be made. The services of an intermediary are unnecessary in approaching the Department for this purpose.

Before being placed on the lists of tenderers, firms will have to satisfy the Department that they actually manufacture goods for which they wish to be noted, and will be required to furnish the names of at least two well-known firms or public bodies who have purchased from them and are in a position to certify as to the quality of their productions. They will further have to give an undertaking that they will comply with the Fair Wages Resolution of the House of Commons.

Attention is called to the following resolution passed by both Houses of Parliament on 16th February, 1926 :—

"That, in the opinion of this House, it is the duty of the Government in all Government contracts to make provision for the employment to the fullest possible extent of disabled ex-Service men, and to this end to confine such contracts, save in exceptional circumstances, to employers enrolled on the King's National Roll."

SALES.

From time to time the Department has for sale surplus Army stores of various descriptions, among which may be mentioned Machinery, Scrap Metals, Hutting, Motor Vehicles and Spare Parts, Medical and Dental Stores, Veterinary Stores, Optical and Scientific Instruments, Electrical and Wireless Stores, Clothing, Boots, Textile Goods, Explosives and Chemicals (including Drugs, Ammonium Nitrate, Sodium Picrate and Cordite).

Firms who wish to be invited to Tender for the purchase of surplus stores should apply as directed below.

All applications should be in writing and should be addressed to the Director of Army Contracts, Caxton House (West), Tothill-street, Westminster, London, S.W. 1. No application is necessary from firms whose names are already on the War Office Lists, unless they have extended the range of their manufactures.

FRANCIS OSBORN,
Director of Army Contracts.
7989

HEATING.

The Commissioners of

His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Wednesday, 27th January for ACCELERATED LOW-PRESSURE HOT WATER HEATING, &c., at the Post Office, Barrow-in-Furness, Lancs.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions.
8004

Brighton Technical College.

PRINCIPAL : W. MANSERGH VARLEY, M.A., D.Sc., Ph.D.

APPLICATIONS are INVITED for an ASSISTANT LECTURESHIP in ENGINEERING in the Mechanical and Civil Engineering Department. Candidates should hold a good honours degree in engineering and have experience in Civil Engineering Work, including Structures and Surveying.

Salary according to Burnham Scale, with usual allowances up to five increments, for suitable professional experience. Applications, on forms to be obtained from the undersigned, will be received up to January 16th, 1932.

F. HERBERT TOYNE, B.A.,
Secretary.

Education Offices,
54, Old Steine, Brighton.
7968

City of Chichester.

The Electricity Committee of the Chichester Corporation invite TENDERS for the PURCHASE and REMOVAL of the following PLANT, which has been displaced or superseded by taking a bulk supply and change of system :—

One Rotary Converter Set, 220 kVA, 11,000 volts/500 volts D.C., together with Transformer and Starting Pillar at present in use.

One Rotary Converter Set, 440 kVA, ditto, with D.C. Control Board for each.

One 300 B.H.P. Vickers-Petter Semi-Diesel Oil Engine and Generator.

One 150 B.H.P. Mirrlees, Bickerton and Day Diesel Oil Engine and Generator.

All necessary Fuel Storage Tanks and Water Circulating Pumps and Control Panels for above.

Numerous D.C. Motors and Starting Panels displaced by change over, a list of which will be sent upon request.

Tenders invited by the 18th inst.

R. V. WEARE, A.M.I.E.E.
Electricity Office, Chichester.
8000

The Engineer

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PUBLIC NOTICES.

Borough of Bedford.

TENDERS are INVITED from British manufacturers for :—

(A) 25 STEEL HOPPER TYPE 20-TON WAGONS.
(B) 50 STEEL HOPPER TYPE 12-TON WAGONS.

The specification and form of Tender may be obtained on payment of a deposit of £3 3s., which sum will be returned if a bona fide Tender is submitted.

Applications for the specification, &c., to be sent to R. W. L. Phillips, M.I.E.E., Borough Electrical Engineer, Bedford, not later than Thursday, the 14th inst., and Tenders are to be delivered on or before Noon, Wednesday, the 3rd February, 1932.

The lowest or any Tender will not necessarily be accepted.

H. DARLOW,
Town Clerk.
Bedford, January, 1932.
7983

Borough of Ilkeston.

MARLPOOL RESERVOIR.

CONTRACT NO. 3.—PIPE LAYING.

The Corporation invite TENDERS from experienced contractors for the LAYING of about 1 1/3 MILES of 16in. and 14in. CAST IRON PIPES and SPECIALS with VALVES, &c. The pipes will be supplied by the Corporation.

The work will extend from the new Marlpool Reservoir at Heanor to the existing Reservoirs at Shipley, in the County of Derby.

The general conditions, specification, schedule of prices and form of Tender prepared by the Engineer, Herbert Lapworth, D.Sc., M. Inst. C.E., 25, Victoria street, Westminster, S.W. 1, may be obtained from the undersigned on application on or after Monday, the 11th January, on payment of a cheque of £3 made payable to the Ilkeston Corporation, which will be returned on receipt of a bona fide Tender.

Facilities for seeing the drawings and inspecting the site and general information may be obtained from George Smith, Assoc. M. Inst. C.E., Borough Surveyor, Town Hall, Ilkeston.

Sealed Tenders, endorsed "Tender for Marlpool Scheme Pipe Laying, Contract No. 3," to be sent to the undersigned and received not later than 10 a.m. on Monday, 1st February, 1932.

The general conditions of contract will contain special conditions laid down by the Unemployment Grants Committee, and the Tenders are subject to the sanction of the Ministry of Health and Unemployment Grants Committee being obtained.

The Corporation does not bind itself to accept the lowest or any Tender.

E. I. E. WILLIAMS,
Town Clerk.
Town Hall, Ilkeston,
2nd January, 1932.
7985

PUBLIC NOTICES.

London County Council.

TENDERS are INVITED for the EXECUTION of the undermentioned WORK, viz.:—

Installation of Three Lancashire Steam Boilers, Economiser, Fittings and Brickwork Settings, &c., at St. Nicholas Hospital, High-street, Plumstead.

The specificationm form of Tender, &c., in respect of the above work may be obtained on application to Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by cheque, draft or money order to the order of the London County Council.

This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the Chief Engineer, The Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract and "The London County Council Gazette."

No Tender received by the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 18th January, will be considered.

The Council does not bind itself to accept the lowest or any Tender.
7961

31st December, 1931.

The County of London Electric

SUPPLY CO., LTD.

BARKING POWER STATION EXTENSIONS, 1930.
TENDER FOR THE SUPPLY OF AUXILIARY SWITCHGEAR AND ACCESSORIES.

The County of London Electric Supply Company, Limited, are prepared to receive TENDERS for the SUPPLY and ERECTION of the necessary AUXILIARY SWITCHGEAR and ACCESSORIES in connection with Extensions to the Power Station at Barking.

Specifications may be obtained by manufacturers of switchgear from the offices of the Company by application on or after Thursday, 7th January, 1932, and on payment of a fee of £5 5s. for the first copy and £2 2s. for every subsequent copy. Sums paid for any number of copies up to three will be refunded on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Auxiliary Switchgear and Accessories," must be delivered, addressed to the CHAIRMAN and MANAGING DIRECTOR, The County of London Electric Supply Co., Ltd., County House, 46/47, New Broad-street, E.C. 2, not later than Noon on Thursday, 18th February, 1932.

The Company do not bind themselves to accept the lowest or any Tender.
7984

PUBLIC NOTICES.

Congleton Rural District Council.

ODD RODE AND DISTRICT WATER SCHEME.
CONTRACT NO. 6.
PIPE LAYING.

The Council invite TENDERS from experienced contractors for the LAYING of about 35 MILES of CAST IRON PIPES and SPECIALS from 9in. in diameter downwards, together with VALVES, HYDRANTS, METERS, &c. The pipes will be supplied by the Council.

The work will include Pumping, Gravity and Distribution Mains in the parish of Odd Rode, and Gravity and Distribution Mains in the parishes of Church Lawton, Brereton, Betchton, Hassall, Davenport, Church Hulme, Newbold Astbury and Smallwood, all within the Rural District of Congleton, in the County of Chester.

The general conditions, specification, schedule of prices and form of Tender, prepared by the Engineer, Herbert Lapworth, D.Sc., M. Inst. C.E., 25, Victoria-street, Westminster, S.W. 1, may be obtained from the undersigned on application on or after Wednesday, January 6th, on payment of a cheque of £5 made payable to the Congleton Rural District Council, which will be returned on receipt of a bona fide Tender.

Facilities for seeing the drawings and inspecting the site and general information may be obtained from the undersigned, H. Ferrand, Crewe-road, Sandbach.

Sealed Tenders, endorsed "Tender for Pipe Laying, Contract No. 6," to be sent to reach the undersigned not later than 10 a.m. on Thursday, January 28th.

The general conditions of contract will contain special conditions laid down by the Unemployment Grants Committee and the Tenders are subject to the sanction of the Ministry of Health and Unemployment Grants Committee being obtained.

The Council do not bind themselves to accept the lowest or any Tender.

HARRY FERRAND,
Clerk to the Council.
Crewe-road, Sandbach, Ches.,
December 30th, 1931.
7987

King George Hospital—Ilford.

WANTED IMMEDIATELY, an ENGINEER to live on or near the premises, with complete Electrical and Mechanical knowledge, capable of running a steam boiler plant with oil firing equipment, cleaning out and general overhaul of boilers, calorifiers, pumps, &c., including pipes, radiators, steam cooking and sterilising apparatus, and executing the necessary repairs to same. Also to overhaul and execute repairs or replacements to electric lighting and electric power installation throughout the various buildings, including electric lifts and refrigerating plant.—Applications, stating age, whether married or single, and wages required, to be sent to the SECRETARY.
7986

The Manchester Steam Users' Association.

For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam, 20, QUAY-STREET, DEANSGATE, MANCHESTER.
Founded 1854 by SIR WILLIAM FAIRBAIRN.

Certificates of Safety issued under the Factory and Workshops Act, 1901. Compensation for Damages and Liabilities paid in case of Explosions. Engines and Boilers Inspected during construction.
6762

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COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

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For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

ELECTRIC WELDING.—WANTED, REPRESENTATIVE in each area to Sell High-grade British Electrodes and Equipment on commission.—Address, P1894, The Engineer Office.
P1894 A

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State full particulars of experience, age, whether married, and salary required in confidence.—Address, 7993, The Engineer Office.
7993 A

LONDON FIRM of ENGINEERS, Marketing a highly successful Steam Appliance, have VACANCY for DEPARTMENTAL SALES MANAGER, to Appoint, Control and Inspire Sales and Service Agents throughout the country.

Exceptional opportunity for young engineer with energy and imagination and of good character. State very fully particulars of age, education, experience, salary expected and whether disengaged, in confidence.

Address, 8001, The Engineer Office.
8001 A

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The Engineer

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THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

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MANAGER for Coal and Other Materials Handling and Shipping Plant. Applicant must have good personality, adequate knowledge of Modern Design, Manufacture and Erection. Good connection and knowledge of market essential. State age, experience and salary required.
Address, 7997, The Engineer Office. 7997 A

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WANTED, First-class Experienced FOREMAN for Modern Structural Shop; one capable of controlling men, fixing prices for all branches of the trade.
State age, full experience and salary. Applications treated in strict confidence.
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For continuation of For Sale Advertisements see page 58.

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The Metallurgist

"The Metallurgist" is a free supplement accompanying the last issue of "The Engineer" for each month.

It is devoted entirely to the science and practice of Metallurgy—ferrous and non-ferrous.

The following comments by a few of our readers indicate its usefulness in a field hitherto much neglected.

"The supplement is very well arranged and will be of considerable value to the Metallurgical Industry."—Sheffield, February, 1925.

"The advantages gained by the metallurgist and the engineer through closer contact is obvious and your supplement should aid in this...."—Washington, U.S.A., February, 1925.

"... Metallurgical Supplement is undoubtedly very good."—Manchester, January, 1926.

"The Metallurgist is indeed a very splendid paper."

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A Seven-Day Journal

The Compagnie Generale Transatlantique.

THE first proposal by the French Government to refloat the Compagnie Générale Transatlantique was rejected by the Chamber of Deputies because the Socialist minority did not think it went far enough in the way of State control, and others objected to the expenditure of public money upon a private undertaking which was practically bankrupt. Then the effect of the company's failure upon national prestige became so obvious that when an amended proposal was brought in again it passed with a big majority. The amendments are important in the sense that they meet in part the Socialist claims and assure a wider public control over the company's operations. Not only has the State a majority of votes, but some of the more important financial and executive appointments are in its hands, and no contracts to a value of more than 500,000f. can be placed without the approval of the Minister of the Merchant Marine. Another innovation is the appointment on the Board of directors of a representative of labour, and another of the *personnel*. The Compagnie Générale Transatlantique has become to all intents and purposes a State concern, with the participation of shipping companies and the ports, and it will be run largely with State engineers and State officials. As this is supposed to be an emergency arrangement for the refloating of the Company, it is assumed that the State will withdraw from active participation in its management when its financial support is no longer needed, but it is feared by many that, having once taken over the control of the Company, the State will not be disposed to relinquish it, so that the Company will run the risk of suffering from the same influences and interferences that proved disastrous to the mercantile marine when it was owned by the State.

Big Canal Merger.

AN important step in the development of Britain's inland water transport was taken last Friday, January 1st, when three important Midland canal undertakings —the Leicester and Loughborough Navigations and the Erewash Canal—came under the control of the Grand Union Canal Company. By this further merger the twenty-two-year-old ideal put forward by the Royal Commission on Canals in 1909, that the four main water routes converging upon the Midlands should be amalgamated and gradually improved, will be realised in so far as practically the whole of the Midlands to London waterways are concerned. Simultaneously with the taking over by the officials, one of the modern dredgers of the Grand Union Canal Company will leave Tring for Leicester, so that the work of dredging the newly acquired concerns can begin at once. Immediate advantage will accrue to the important industries that are served by the various waterways now linked to London under unified control, inasmuch as the modern plant and water reservoirs owned by the Grand Union Canal Company will be available for clearing the channel, freeing the surface of ice in wintry weather, and maintaining the water level. Thus, canal users throughout the main Midland industrial field will have the satisfaction of knowing that water transport delays due to drought or ice will, thanks to the prompt and efficient measures made possible by unified control, soon be a thing of the past. This latest merger will bring under the control of the Grand Union Canal Company a further 40 miles of waterways, serving Leicester, Loughborough, Nottingham and the Erewash Valley. Ultimately the newly acquired canals will be brought up to the standard to which the Grand Union Canal is being raised under the company's £1,000,000 improvement scheme mentioned in several journal notes last year.

The New Cunard Liner.

As recorded in a Journal note of December 25th, a trade union deputation, consisting of about thirty members of the Federation of Engineering and Shipbuilding Trades, the Boilermakers' Society, and the Amalgamated Engineering Union, waited on the President of the Board of Trade on Tuesday, December 22nd, when suggestions for restarting the construction of the new Cunard liner "No. 534" were put forward. Sir Charles Hipwood, the Second Secretary of the Board of Trade, who received the deputation, then promised that the President would send a reply in due course. The reply sent by Mr. Walter Runciman, which was made public on Tuesday, January 5th, is contained in a letter to Mr. W. Thorne and to Mr. W. Sherwood, who headed the deputation. Mr. Runciman, in acknowledging the receipt of a full report of the deputation's visit, says that while he fully appreciates the points which were put forward, showing the great importance of work on the vessel being restarted, he regrets that he is not in a position to add anything to the statement which he made on the subject on December 11th in the House of Commons. The position remains, he says, unaltered, and the company is relying quite properly on its prudently-regulated financial arrangements. It is not possible to hold out any hopes that financial assistance can be given by the Government, and while fully sympathising with the objects which the deputation had in view, the President does not think that there is any action which he can usefully take in the matter. Following the receipt of this reply, Mr. W. Sherwood, the President of the Federation of Engineering and Shipbuilding Trades, has decided to call a representative gathering of the trade union delegates of the industries affected in Glasgow. This meeting will probably take place at the beginning of next week, and the hope is expressed that both the owners and the builders of the ship will co-operate with the trade unions in endeavouring to overcome the obstacles in the way of the resumption of work. If the difficulties are found to be purely financial, it is hoped that a further joint appeal to the Government may be made.

Large Order for British Aircraft.

THE confidence of foreign countries in the designs of aircraft made in this country is well illustrated by the news that a £300,000 order has just been received by the Fairey Aviation Company, of Hayes, Middlesex, through its subsidiary, Avions Fairey, from the Belgian Government for sixty machines. The aircraft to be delivered under the order are of two types. One, the "Fox II. M," is a two-seater, high performance day bomber. It is driven by a single 480 H.P. Rolls-Royce "Kestrel" supercharged, water-cooled engine, and is armed with one fixed Vickers gun, firing through a trough in the side of the fuselage, and one Lewis gun on a special mounting in the back cockpit. It can carry two 230 lb. or four 112 lb. bombs. The other type of machine is the "Fairey Firefly II. M," a single-seater, high-performance fighter. This latter machine is said to be capable of a speed of 223 m.p.h., and to be controllable up to a speed of nearly 400 m.p.h. in a vertical dive. It is driven by a single Rolls-Royce "Kestrel" supercharged water-cooled engine. Both types of machine are designed to develop their highest air speed and power at altitudes between 20,000ft. and 30,000ft. This order follows one valued at nearly £400,000 placed by the Belgian Government a year ago for eighty "Fairey" machines.

An Italian Shipping Merger.

LAST year preliminary steps were taken to form a single shipping company by the fusion of interests of the Navigazione Generale Italiana, the Cosulich, and the Lloyd-Sabaudo lines. The new company, which has been styled the Italia Steamship Company, began its career on Saturday last, January 2nd, when its charter deeds were formally signed by representatives of the three shipping companies mentioned. The Duke of the Abruzzi, a cousin of the King of Italy, has been unanimously elected President of the new undertaking, while Senator Vittorio Rolandi Ricci, the President of the Navigazione Generale Italiana, and Senator Salvago Raggi Giuseppe, the President of the Lloyd-Sabaudo Company, have been made vice-presidents of the new company. It has been decided to distinguish all ships in the newly created fleet by funnel marks, consisting of the national red, white and green colours, and the ships now at sea will be brought under the control of the new company as soon as they enter a home port.

The Middlesex Sewerage Scheme.

ON Saturday last a numerous company of engineers and others visited the site at Twickenham, where it is proposed to found the new sewage disposal works of the Middlesex County Council. The inspection was made at the invitation of the Ham River Grit Company, Ltd., which will carry out the excavation of the material—said to amount to 750,000 tons—that it will be necessary to remove for the construction of the works. The ceremony of putting in operation pumping and conveying machinery which has been installed for the purposes of the excavation was performed by Mr. G. Marlow Reed, the Chairman of the Middlesex County Council. The work of excavation, which is to be largely performed by means of pontoon dredgers, will, at first, result in the formation of a lake, which, it is stated, is likely to contain as large a volume as 750,000,000 gallons of water, all of which will have to be pumped out. When completed, the disposal works will, it is believed, be the largest sewage treatment installation in Europe. The cost of the scheme, which has to be completed within four years, will, when carried out in its entirety, amount, it is understood, to between £5,000,000 and £6,000,000.

Industrial Activity in Birmingham.

FROM the City of Birmingham Information Bureau we learn that the trade outlook in the area is distinctly cheering. Many firms are working overtime, while others are increasing their staffs and their works in order to cope with a steady flow of orders. This applies to such diverse industries as light motor cars and heavier commercial vehicles, electric furnaces, cutlery, wireless parts, including radio components, valves and bakelite manufactures. We are informed that within the last month an increase in the industrial power load of about 17,000 kW has been recorded. A large area of land in Birmingham has recently been purchased by Slough Estates, Ltd., with the object of developing it along the lines of the company's industrial estate at Slough. Several firms from abroad have already taken factories in the Birmingham area and are manufacturing goods which previously were not made in this country. The Information Bureau of the City of Birmingham is in communication with nearly forty firms, all of which have announced their intention to manufacture in Great Britain. Inquiries have been received at the Bureau from France, Belgium, Holland, Germany, and America, and in some cases representatives of the firms have visited Birmingham and inspected the sites available. The Bureau has also recently got into touch with a large number of foreign manufacturers who, in view of the change in the fiscal policy and the departure from the gold standard, will need to consider setting up a factory in England.

The Clyde Navigation Trust.

AT a meeting of the Clyde Navigation Trustees, held in Glasgow on Tuesday last, January 5th, Mr. W. F. Robertson, who presided, said that 1931 would stand out as a year of difficulties. The year 1932 might also bring difficulties, but these, with good will and co-operation, they would face and surmount. The last three months of the year compared not so badly with the corresponding months of the previous year. In reviewing the progress made, Mr. Robertson stated that necessary reconstruction work at the general terminus and the Plantation quays had gone forward, and in addition to extra quay space when the work was finally completed, they would have a depth of 24ft. of water, as against only 14ft. before the improvements were made. The large graving dock had been deepened by 20in. over a length of about 800ft., which work would, he thought, give great satisfaction to the owners of the largest loading vessels. The large fitting-out crane, which was being erected at Stobcross by Cowans, Sheldon and Co., Ltd., of Carlisle, was now nearing completion. It was designed to lift a load of 175 tons to a height of 150ft. above the top of the quay wall at a radius of 85ft., and before it was taken over it would be tested with a load of 220 tons. The first part of the widening of the Clyde at Clydebank for the new Cunard liner was completed on November 17th, when dredging was immediately begun in readiness for the launch. This work, however, was stopped on December 14th, but the plant was now being usefully employed in the construction of the new large graving dock for Barclay, Curle and Co., Ltd.

Tramways and Trolley Buses.

AT a meeting of London United Tramways, Ltd., held on Tuesday, January 5th, a resolution was adopted approving the promotion of a Provisional Order authorising the company to use trolley omnibuses on an additional route in the county of Surrey. In supporting the resolution, Mr. H. A. Vernet, the chairman, said that under the provisions of a Bill promoted in 1930 tramways had been replaced by trolley omnibuses over a system of 17 miles between Twickenham and Kingston, Kingston and Wimbledon, Kingston and Tolworth, and Surbiton and The Dittons. The extension contemplated in the new Bill was in the Tolworth area and would cost, it was estimated, including the vehicles and the power supply, less than £11,000. The change over from tramcars to trolley vehicles had met with public approval. The cost of operation of trolley omnibuses per car mile was about 15 per cent. less than the average cost of running tramcars. That was in part owing to the heavy burden of road maintenance charges imposed upon the tramways. Against that charge, however, was the licensed vehicle duty of the trolley omnibus, which amounted to £86 per vehicle per annum.

The Late Mr. Oliver Stubbs.

IT is with great regret that we record the death of Mr. Oliver Stubbs, who died in Manchester on January 4th, after a very long illness. Mr. Stubbs was the fifth son of the late Mr. Joseph Stubbs, a textile machinery manufacturer. After serving an apprenticeship with John Hetherington and Son, Ltd., he joined the firm of Joseph Stubbs, Ltd., eventually becoming joint managing director with his brother, the present Mr. Joseph Stubbs, and was particularly associated with the Openshaw foundries of the firm. Mr. Oliver was a member of the Institution of Mechanical Engineers and was President of the Institute of British Foundrymen in 1921, and again in 1923. He was also President of the National Iron Founders Employers' Federation from its inception in 1915 until he retired owing to ill-health a few years ago. The Oliver Stubbs Medal, awarded annually by the Institute of British Foundrymen, is presented by the National Iron Founders Employers' Federation to commemorate his presidency of the two organisations. Early in 1923 he visited the United States, largely in the interests of the Institute of British Foundrymen, and was partly instrumental in promoting the close co-operation which exists between the foundry technical associations in various countries. He was one of the originators of the British Cast Iron Research Association, and was a Vice-Chairman of the Council until 1931, when he was elected a Vice-President.

The Gyroscopic Stabilising Equipment of the Lloyd Sabaudo Liner Conte di Savoia.

No. I.

IT has been known for some time past that the new 45,000-ton Transatlantic liner "Conte di Savoia," now being completed for the Lloyd Sabaudo Company by the Cantieri Riuniti dell' Adriatico at Trieste, is to be provided with Sperry gyroscopic stabilising equipment. That equipment, consisting of three separate units, each with a fly-wheel 13ft. in diameter and weighing 110 tons, has been constructed in this country under the supervision of Mr. F. P. Hodgkinson, of the Sperry Gyroscope Company, Ltd., Brentford, Middlesex, the mechanical portions having been made by Vickers-Armstrongs, Ltd., at Barrow-in-Furness, and the electrical portions by the Metropolitan-Vickers Electrical Company, Ltd., at Trafford Park. By courtesy of the Sperry Company we were recently afforded an opportunity of inspecting the equipment during and following official tests at the Naval Construction Works, Barrow, just before it was shipped to Italy.

Some years ago a Sperry stabiliser with a fly-wheel weighing 62 tons was supplied for the 10,000-ton Japanese aircraft carrier "Hosho." That equipment continues, it is understood, to give satisfaction. With its exception, however, gyroscopic stabilisers have in the past been fitted almost exclusively to vessels of the pleasure yacht class. A recent noteworthy installation in a vessel of that description is the equipment fitted in the motor yacht "Savarona," built within the past twelve months for an American owner by Blohm and Voss, of Hamburg. This vessel, stated to be the largest motor yacht in the world, has a displacement of 5600 tons and is equipped with a Sperry stabiliser having a fly-wheel weighing 45 tons. This equipment, we learn, has given a very good account of itself during rough weather in the North Sea. Another notable example of a vessel stabilised gyroscopically will be provided by a new Italian destroyer which is to be fitted with a Sperry equipment of much the same size as that on the "Savarona." From these brief particulars it will be gathered that the stabilisers for the "Conte di Savoia" represent a very marked forward step, both as regards their size and the class of vessel on which they are to be used. In many quarters gyroscopic stabilisers are still regarded as experiments of doubtful expediency and at the best as being suited only to small ships. The results obtained with the equipment now being installed on the new Italian liner will, it is hoped, be duly published. They will certainly attract wide attention. Meanwhile in what follows we give a full description of the construction and action of the equipment.

A gyroscope is, at least theoretically, capable of applying to a ship a reaction which at each and every instant will just balance the heeling moment applied to her by the waves. In that event the ship will be completely stabilised and will ride over the waves without rolling. Since the ship does not roll, she acquires no energy from the waves and therefore the stabilising equipment is not called upon to provide any means for dissipating energy communicated to the hull from the waves.

It is possible to conceive a gyroscopic equipment that will operate in an entirely different manner. It might work, not by applying a direct reaction opposing the heeling moment, but purely by providing a means for the quick dissipation of the energy communicated to the hull from the waves. In that event the ship would roll, but the rolling motion would be subjected to the damping action of the stabilising equipment. The stabiliser would in effect act as a powerful reinforcement to the action of the bilge keels and hull resistance. The rolling energy would leak away quickly and would not accumulate to an extent sufficient to roll the ship through more than a few degrees. In short, the equipment would act as an anti-rolling brake. The stabilisation in this case would be partial. The braking or energy-dissipating function of the equipment would, in accordance with the principles governing the design of a satisfactory damping device, be zero when the ship was not rolling and rise as the velocity of rolling increased. Hence the action of the system would be dependent upon the acquisition of some rolling motion by the ship. With a high degree of damping the maximum roll acquired by the ship would be small and a high, but not complete, degree of stabilisation would be realised.

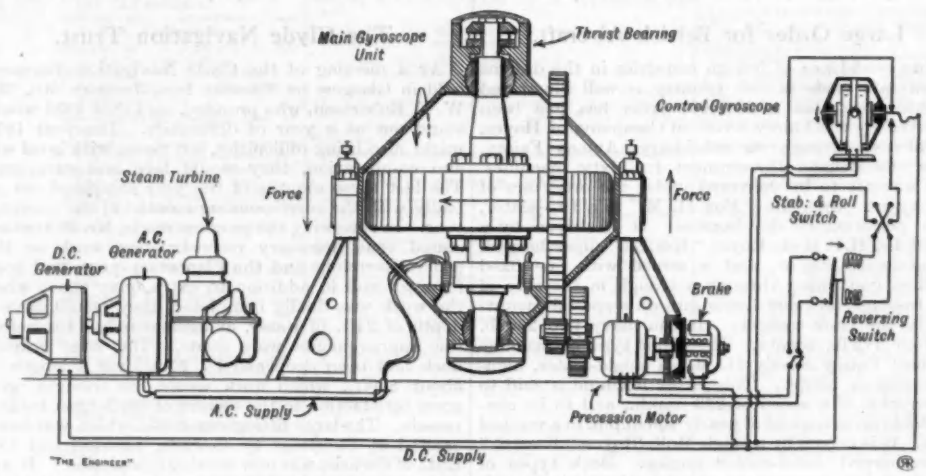


DIAGRAM OF SPERRY STABILISING SYSTEM

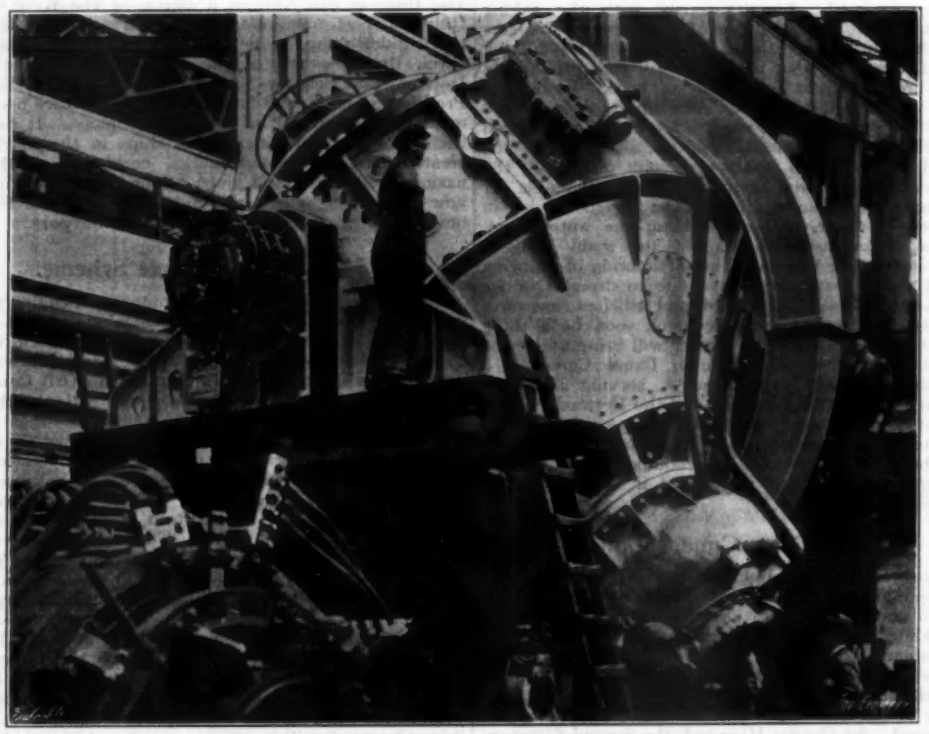
No system of automatic ship stabilisation yet tried works purely on either of these principles. The case of the Frahm anti-rolling tank system is typical. The water in the Frahm tanks, oscillating across the ship out of phase with the vessel's rolling motion, serves, by its displaced weight, in some measure to counteract directly the heeling moment of the waves. The residue of the heeling moment is available to roll the ship. The rolling motion so acquired is damped by the frictional resistance experienced by the water and air moving backwards and forwards through, respectively, the lower and upper passages connecting the side tanks.

Similarly in certain systems of gyroscopic stabilisation, such as the Schlick and the Fieux, the gyroscopic reaction applied at the athwartship or precessional journals of the equipment does not reach a magnitude which at all times is sufficient to counteract the heeling moment in action on the hull. The residue of the heeling moment is available to roll the ship, and the rolling motion engendered by it is damped by means of a hydraulic or mechanical friction brake forming a part of the equipment.

In a gyroscopic stabilising system the provision of a damping brake for the dissipation of the rolling energy acquired by the ship can, in general, only be effected by a sacrifice of some portion of the ability of the gyroscope to stabilise the ship by direct reaction. In other words, the size and weight of equipment required for a given vessel are, broadly speaking, much the same whether partial or complete stabilisation is aimed at. The preference shown by several inventors for partial stabilisation does not therefore spring from any marked economy in the weight of equipment required. It resides very largely in the practical difficulty of fulfilling the conditions for complete stabilisation.

For complete stabilisation by pure reaction no energy-dissipating or brake system, as already noted, is required. Instead, as can readily be shown, the requirement to be fulfilled is the application to the gyroscope about its precessional axis of a moment or couple, which will cause it to precess with the particular velocity required at any instant to give a gyroscopic reaction the vertical component of which shall be equal and opposite to the heeling moment in action on the ship. It is in the determination and application of this moment that the chief difficulty of fulfilling the requirements for complete stabilisation resides. The magnitude of the moment required is determined by the wave characteristics—specifically by the ratio of their height to their length—and the period of its application is determined by the period of the waves. The problem involved in effecting complete stabilisation therefore consists, first, of detecting in some automatic manner the period, height and length of the waves acting on the ship and then of applying, without a time lag, a moment about the precessional axis of the gyroscope, the magnitude and period of action of the moment being determined in accordance with the detected wave characteristics.

In his first approach to the study of automatic ship stabilisation by means of gyroscopes the late Dr. E. A. Sperry had before him the ideal of providing a system of complete stabilisation. The Sperry system as developed in practice departs from the full realisation of this ideal, but it approaches nearer to it than any other system that has been tried. In it the problem is, as it were, short-circuited. The period of the waves acting on the ship is automatically determined and the length of time between the application and removal—or reversal—of the precessional moment is automatically settled by the detected wave period. No attempt is, however, made to determine the height-length ratio of the waves. The magnitude of the precessional moment is fixed without specific reference to that ratio and is determined, more or less arbitrarily, by those responsible for the design and operation of the equipment.



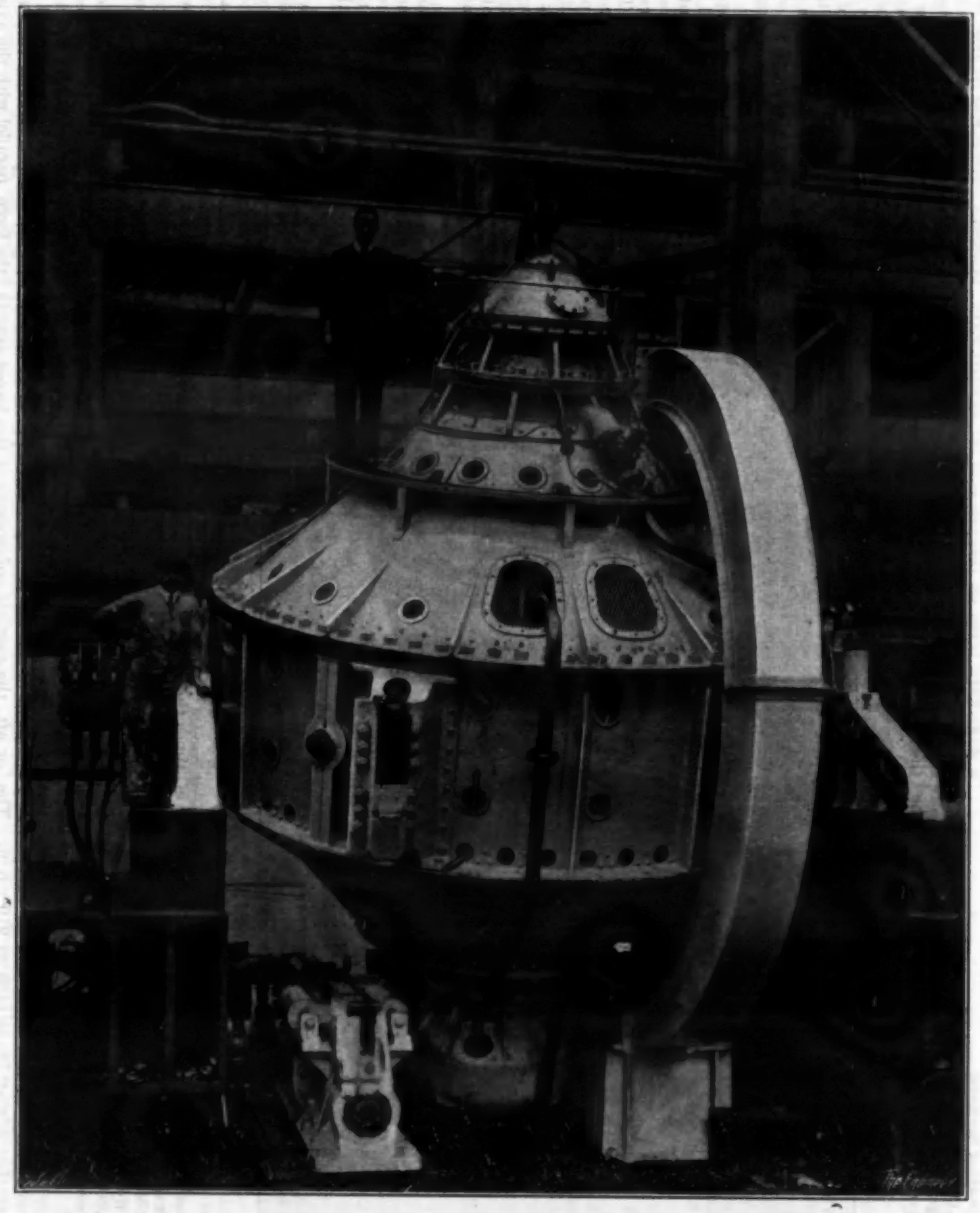
STABILISER TILTED ABOUT PRECESSIONAL AXIS

The general principle of the Sperry system was discussed in some detail in our issue of June 6th, 1930, in the tenth of our series of articles on "The Automatic Stabilisation of Ships."* The accom-

* This series has recently been republished in book form by Chapman and Hall, Ltd., London.

GYROSCOPIC STABILISER UNIT FOR THE "CONTE DI SAVOIA"

SPERRY GYROSCOPE CO., LTD., LONDON, ENGINEERS; VICKERS-ARMSTRONGS, LTD., AND METROPOLITAN-VICKERS ELECTRICAL CO., LTD., CONSTRUCTORS



FRONT VIEW SHOWING BUFFER STOP

SIDE VIEW SHOWING PRECESSING GEAR

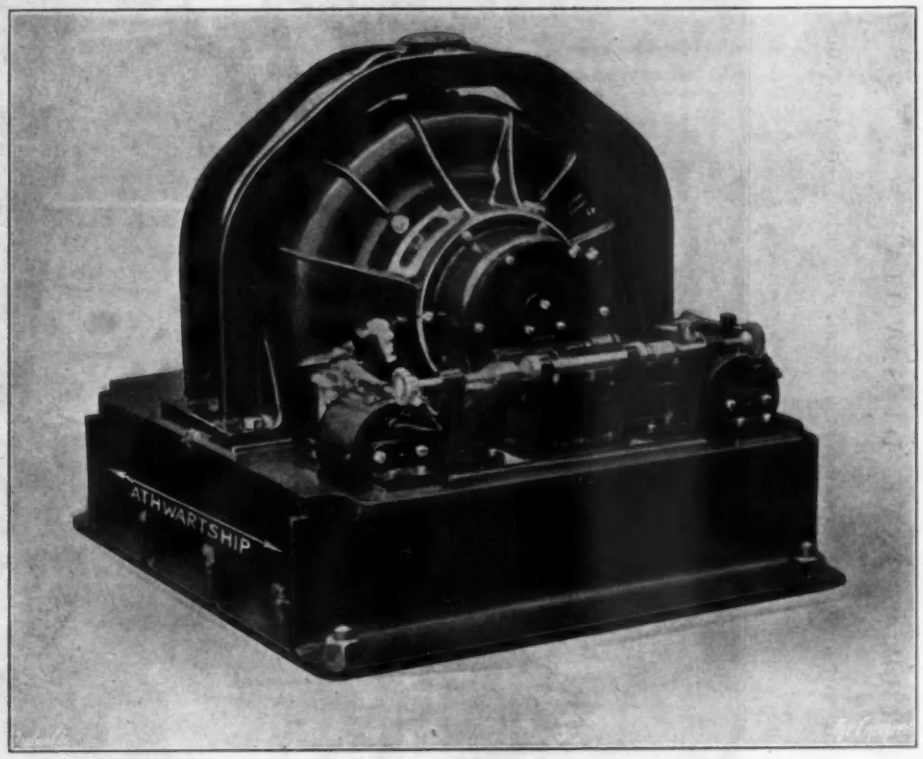
panying diagram is reproduced from that article. The device employed for detecting the period of the waves is a small, sensitive pilot or control gyroscope. Immediately, or almost immediately, upon the receipt by the ship of a heeling moment from the waves, this gyroscope precesses and closes one or other of a pair of electrical contacts, the precise contact established being dependent upon the direction in which the heeling moment tries to roll the ship. On the closing of this contact—contact A, let us call it—D.C. energy is admitted to a circuit containing a magnetic brake and a motor, referred to as the precession motor. The energisation of this circuit pulls the brake shoes magnetically off the brake drum against the action of springs, and with the brake thrown off in this manner the precession motor starts to rotate. This motor is geared to a toothed ring surrounding the casing of the main or stabilising gyroscope. That gyroscope consists of a fly-wheel spun by an A.C. motor, and mounted inside a casing which is swung on an athwartship axis. In the normal or zero position, the axle of the fly-wheel is vertical. The forced precession applied to the gyroscope by the precession motor tilts the axle forward or aft, and, as a consequence, a reaction is manifested at the athwartship bearings of the gyroscope casing, namely, a downward thrust on one bearing and an upward lift on the other. The forces applied to the bearings in this way are so directed as to oppose the heeling moment acting on the ship. These forces are distributed through wide-spreading pedestals to the ship's framing.

With the disappearance of the heeling moment, or just before it disappears, the control gyroscope ceases to be able to maintain the contact previously established and is centralised by means of springs. Current is therefore cut off from the precession motor and magnetic brake, and the brake shoes are forced by their springs against the drum. Under the action of this braking force the main gyroscope ceases to precess about the athwartship axis and comes to rest with its axle tilted forward or aft.

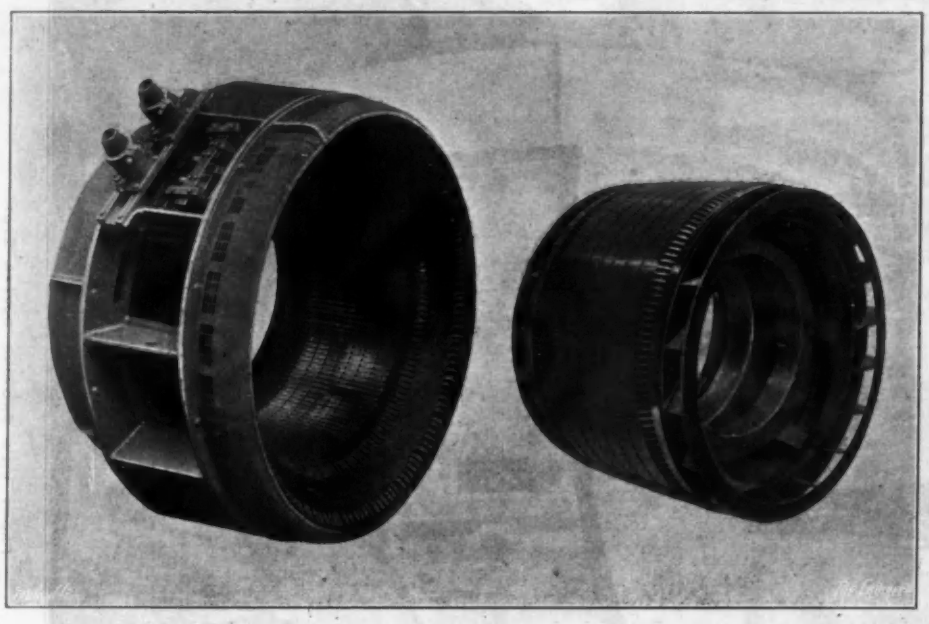
Had the heeling moment been in the reverse direction, the control gyroscope would have closed contact B instead of contact A. The magnetic brake would have been pulled off as before, but the precession motor would have started up in the reverse direction. The reverse direction of the precession would have reversed the direction of the reaction forces at the precessional bearings and these forces would oppose the reversed heeling moment. With the disappearance of the heeling moment the main gyroscope would come to rest with its axle tilted aft or forward.

If the heeling moment is one which reverses its direction at regular or irregular intervals, as it is in the case of a ship exposed to a train of waves, the main gyroscope will be precessed or rocked continuously to and fro in tune with the fluctuation of the heeling moment.

The magnitude of the reaction at the athwartship bearings depends upon three factors, the moment of inertia of the fly-wheel, its speed of spinning and the precessional velocity. The first of these factors is determined by the designer and is not subsequently variable. In the "Conte di Savoia" equipment each fly-wheel has a polar moment of inertia of 4,900,000 in pounds and feet. The second factor, the speed of spinning, is variable over a considerable range. The usual operating speed in the equipment for the Italian liner will be 800 r.p.m., but in bad weather it may be increased, and in exceptionally bad weather it may be as high as 910 r.p.m. The precessional speed is also variable. In the "Conte di Savoia" equipment, the precession motor speed is adjustable between 250 and 300 r.p.m. at full voltage, and may be farther adjusted by varying the voltage. The total range is such that the gyroscope may be moved from 60 deg. of forward tilt to 60 deg. of tilt aft in anything from 8 to 18 seconds. The angular velocity of spin of the wheel is therefore from 83·76 to 95·28 radians per second, while the precessional velocity may be anything from 0·116 to 0·262 radian per second. Multiplying the three factors together and dividing by the acceleration due to gravity we find that the gyroscopic reaction couple may be anything from 1,480,000 to 3,800,000 pounds-feet. The distance apart of the precessional trunnions being 15ft. 6in., it follows that the force exerted on the bearings by the gyroscopic reaction—a downward force on the one and an upward force on the other—may be anything from about 42 tons to about 109 tons. The total reaction transmitted from the bearings to the hull may be once, twice, or three times these figures, according as one, two or three of the stabilising units are in use.



CONTROL GYROSCOPE UNIT



SPINNING MOTOR: STATOR AND ROTOR

It should be noted that as the gyroscope tilts the direction in which the forces on the bearings act tilts with it. The direction of the forces remains in fact constantly parallel with the axis of spin of the fly-wheel. When that axis is vertical, the full value of the forces is available for counteracting the heeling moment of the waves. As the axis precesses forward or aft, the vertical component of the forces acts in opposition to the heeling moment. The horizontal component, growing from zero when the spinning axis is vertical to a maximum value when that axis reaches the limit of its oscillation, applies an oscillating yawing moment to the ship's hull.

It will be realised that the arrangements provided in the equipment for the "Conte di Savoia" allow those in charge of it a considerable degree of latitude in the manner in which it may be operated. Apart from the fact that they may bring one, two, or three of the units into action, they have power to control the speed of spin and the speed of precession, and to arrange them at the values that will best suit the prevailing wave conditions. The speed of spin, as has been said, can be varied from 800 to 910 r.p.m., but it is anticipated that normally the wheels will be run fairly constantly at about the lower figure. The principal control will be that of the speed of precession. In that respect there will be considerable opportunity for the exercise of judgment enlightened by experience. The operator has no control over the interval between the instants at which the precession reverses its direction. The period of the rocking motion is determined automatically by the control gyroscope in accordance with the period of the waves. By varying the precessional velocity, the operator therefore effects a variation in the angle of tilt reached by the gyroscope at the ends of its swing. That angle is limited by stops to about 60 deg. forward and 60 deg. aft.

In fixing the precessional speed to suit any prevailing wave conditions regard has to be paid in the first instance to the requirement that it will not be so great as to bring the main gyroscope against the stops before or at the end of the interval of time determined by the control gyroscope. The stops are safety devices to prevent the gyroscope from reaching an excessive angle of tilt, and possibly turning right over. If they are struck, as will be explained in detail later, they automatically lock the gyroscope in its tilted position. The stabilising action of the equipment thereupon ceases completely and at once, and will not be resumed until, the cause of the striking having been investigated and rectified, the lock is released by hand.

A second consideration tending to encourage the adoption of a low rather than a high precessional velocity resides in the influence which that velocity has upon the magnitude of the horizontal yawing moment which accompanies the vertical stabilising moment. The precessional velocity affects the yawing moment in a double way. The higher it is, the greater will be the force, parallel with the spinning axis, acting on the precessional trunnion bearings. The higher it is, too, the greater will be the angle of tilt reached by the gyroscope at the end of its swing, and consequently the greater will be the maximum value of the horizontal or yawing component of the force acting on the bearings.

A third consideration influencing the choice of the precessional velocity is the manner in which it affects the all-important vertical or stabilising component of the gyroscopic reaction. Here, again, the precessional velocity has a double effect, but the two aspects are now opposed to one another. The higher the precessional velocity, the greater will be the force, parallel with the axis of spin, acting on the bearings. The vertical component of this force, however, diminishes with the angle of tilt. Hence,

what the stabilising moment gains by the increase in the force on the bearings is in some measure lost by the decrease in the vertical component accompanying the greater angle of swing.

In a completely stabilised ship the vertical component of the gyroscopic reaction would at each and every instant exactly balance the heeling moment. To fulfil this condition, it is necessary that the stabilising gyroscope should pass through the vertical or midpoint position of its swing, with a certain velocity, and that this velocity should diminish regularly and smoothly until it just falls away to zero at either end of the swing. In the Sperry system the precessional velocity, once set, remains constant throughout the swing, except during a small portion at the beginning and end of each swing, when the movement is being started and stopped respectively. The general result is that during part of each swing, the stabilising component of the reaction is less than that required to give complete stability, while during another part of the swing it is greater. The system cannot therefore impart complete stability to the ship, but, as no doubt will be readily inferred, it can go a very long way towards effecting a substantial approach to complete stability. In certain cases it has succeeded in holding the ships fitted with it steady to within 2 deg. of rolling.

One remark made in the above paragraph may appear more obvious than it really is. We have said that the precessional velocity once set remains constant. Actually, it remains constant to within about ± 5 per cent. The action which takes place is worthy of note. If the main gyroscope were free from the restraint of the precession motor and its gearing, the heeling moment acting on the hull, and through the hull on the gyroscope, would cause the fly-wheel to precess with a certain velocity natural to its moment of inertia, its speed of spin and the magnitude of the heeling moment. The coupling up of the gyroscope to the precession motor does not eliminate the effort made by the gyroscope to precess with its natural velocity. It may happen that this "natural" velocity is less than the velocity at which the precession motor is set to turn the casing on the athwartship axis. In that event, the precession motor will be called upon to supply the power requisite to make up the difference between the two speeds. It may, on the other hand, happen that the "natural" precessional velocity is greater than that corresponding to the setting of the motor. In that event, the casing and gearing will transmit a drive to the motor, which will thereupon generate a back E.M.F. opposing the voltage in the supply circuit. There will then be a weakening of the current in the coils of the magnetic brake, which, as a consequence, will come partially into action and check the effort of the gyroscope to precess more quickly than the speed corresponding to the setting of the precession motor. The net effect is that the gyroscope always precesses at a speed which does not vary by more than about 5 per cent. above or below the speed set by the precession motor.

The Sperry system falls short of the full requirements for complete stabilisation by reason of the fact that the magnitude of the precessional moment is determined arbitrarily and not automatically in accordance with the prevailing wave characteristics. Looked at in a simple way, the precession motor is merely a means for rocking the gyroscope at a controllable speed about the athwartship axis. Looked at from the point of view of the theory of complete stabilisation, the precession motor and the magnetic brake are seen to be a means of applying the required retarding or assisting moment about the precessional axis. When he varies the speed setting of the precession motor, the operator is in effect varying the magnitude of the retarding and assisting moment applied to the gyroscope, and is thereby enabled to adjust the action of the system some way towards the requirements for the complete stabilisation of the ship under the prevailing wave conditions.

Complete stabilisation is an ideal and probably always will remain an ideal. The theory of it, however, provides a useful light in which to examine the action of any actual system of stabilisation. No criticism of the Sperry system is therefore implied by any remarks we have made above concerning its departure from fulfilling the requirements for complete stabilisation.

On page 33 we give two general views of one of the stabilising units for the "Conte di Savoia." In next week's issue we will illustrate and describe some of the constructional features of the equipment, and its arrangement on the ship.

(To be continued.)

OBITUARY.

MR. A. J. BARTLETT.

THE death is announced of Mr. A. J. Bartlett, the sales superintendent of Petters Ltd., Oil Engine Manufacturers, of Yeovil, as having occurred on December 26th after a short illness. Mr. Bartlett, who was only forty-three years of age, had been connected with the firm for over twenty years, and was a well-known and popular figure at leading agricultural shows and exhibitions.

Naval Construction in 1931.

By HECTOR C. BYWATER, A.I.N.A.

No. II. *(conclusion).**

Germany.

INTEREST in that much-advertised warship the "Deutschland" was revived by her launch at the Deutsche Werke, Kiel, on May 31st, 1931. She had been thirty-one months on the stocks, and it would be interesting to know whether this slow rate of construction was due to complexity of design, the extensive use of electric welding, or financial reasons. Delivery of this "pocket battleship" is expected to be made about four years after the laying of her keel. She was described in our last annual review, but it may be convenient to restate the principal features of the design. The ship has a length of 609ft. 3in. overall, with a breadth of 67ft. 6in., and draws 21ft. 8in., the "standard" displacement being 10,000 tons, this figure being the maximum permitted by the Versailles Treaty. Everything possible has been done to save weight. Only steel of the highest quality is used in the construction, and wherever feasible the electric torch has replaced the riveting hammer. As a result the hull is claimed to be over 500 tons lighter than it would have been if constructed on conventional lines. An armour belt of unknown strength has been worked into the hull amidships, and there are double protective decks over the more vulnerable spaces. Extensive subdivision has been employed as a defence against under-water attack. As the forecastle deck is carried well aft the ship has a fairly high freeboard, and in spite of the heavy deck load which she carries, the model tank experiments give promise of stability and seaworthiness. For her tonnage the "Deutschland" will be the most heavily armed vessel in the world. She will mount six 11in. 50-cal. guns in triple turrets fore and aft; eight 5·9in. Q.F. mounted singly on deck behind shields; four 3·4in. A.A. on twin mounts, and two sets of triple 19·7in. torpedo tubes, one at each side of the quarterdeck. There is a spacious bridge surmounted by an armoured gun control tower with a 30ft. base range-finder, a heavy steel foremast carrying the director top, and one large funnel.

The "Deutschland" will be the first armoured ship of considerable tonnage to be propelled entirely by internal combustion engines, and full details of her machinery are now available. It comprises eight compressorless, double-acting, two-stroke, M.A.N. Diesel engines, each set of four engines driving a single propeller shaft through a Vulkan hydraulic gear. Each of the nine working cylinders of an engine unit has a diameter of 420 mm. and a piston stroke of 580 mm. At full power, 450 r.p.m., the plant develops 56,800, and when allowance has been made for loss of power through the hydraulic coupling and the gears it is estimated that 54,000 H.P. will be transmitted to the propellers. It should be added that the Vulkan gear reduces the speed of the shafts to 250 r.p.m. The entire installation is said to be unique in the power developed proportionate to its weight. At the same time the original claim that a unit of horse-power was generated for every 17½ lb. of weight is now shown to be misleading. The gross weight works out at 45½ lb. per unit of power, and while this achievement represents a notable advance in the fining-down of internal combustion engine weight, it is inferior to the ratio of weight to power exhibited by the latest steam turbine installations in naval practice. From private but trustworthy information I gather that the service figure for the "Deutschland" will be 51 lb. per horse-power. Against this figure the British Navy has developed a turbine plant for light cruisers which produces a unit of power for little over 40 lb. of weight, while in the latest destroyer turbine installations there is a saving of at least 15 lb. as compared with the "Deutschland's" figure. This fact in no way detracts from the technical achievement represented by the engines of the German ship, but it does suggest that the Diesel system is still at a serious disadvantage in comparison with the steam turbine as a prime mover for high-speed fighting ships. Moreover, as the "Deutschland" is not yet completed, the power and efficiency of her propelling plant are still to some extent speculative. She constitutes a bold and praiseworthy experiment—but still an experiment, which may or may not fulfil the somewhat ambitious promises of her authors.

Equally significant from the naval point of view are the cruisers which have been recently completed for the German Navy. In four of these ships the steam turbines which form the main propelling machinery are supplemented by an auxiliary Diesel plant for cruising purposes. The sister ships "Königsberg," "Karlsruhe," and "Köln," have the following characteristics:—Length overall, 570ft.; breadth, 49ft. 10½in.; draught, 17ft. 9in.; displacement, 6000 tons. Electric welding was largely employed in building the hulls. Each vessel is armed with nine 5·9in. guns in triple turrets, one turret being forward and the other two aft, where they are echeloned—presumably to facilitate the lay-out of magazines. There are also four 3·4in. A.A. and twelve torpedo tubes on deck in triple mountings. The steam turbines develop 65,000 S.H.P., the designed speed being 32 knots. No provision was made in the original design for an auxiliary Diesel drive, which was literally an afterthought. It was found that the necessary space was available, and that the additional weight could be accommodated without exceeding the 6000 tons of total displacement. The plant installed in the "Königsberg" and her two sisters comprises two Diesel motors, each of 1000 B.H.P., working through Vulkan reduction gear. For economical reasons the actual output is restricted to 900, so that the combined power of the auxiliary drive is 1800 B.H.P. Intended solely to propel the ship at moderate cruising speed, it adds nothing to her speed when the turbines are running at full power. Its great merit is that it confers upon these small ships a cruising endurance of 18,000 miles, enabling them to cover long distances at a very moderate consumption of fuel. This extraordinary endurance is, of course, a valuable strategic asset, since the vessels are almost independent of shore bases. The ten working cylinders in each motor are 260 mm. diameter and have a piston stroke of 330 mm., the net engine weight being 12·3 lb. per unit of horse-power—a remarkably low ratio. It is ascribed in part to the use of aluminium castings for the engine frames and pistons and in part to meticulous care in design.

In the cruiser "Leipzig," which was commissioned on October 8th, 1931, the system of auxiliary drive has been still further developed. This ship has much the same dimensions and the same armament as her predecessors of the "K" class, and the steam turbine machinery is but little altered. Instead of two shafts, however, there are three, the centre one being driven by the Diesel plant. The latter consists of four seven-cylinder motors generating 3100 B.H.P. each, the total output for service purposes being calculated at 12,000. As this power is sufficient to drive the ship at 18 knots, the Diesel plant, in the case of the "Leipzig," is something more than a mere "auxiliary." The difficulty of synchronising the revolutions of the centre, or Diesel-driven, shaft with those of the wing shafts operated by the turbines was overcome by fitting that shaft with a special propeller with adjustable blades. When the ship is running on her turbines alone the blades of the middle propeller offer only slight resistance. Conversely, when the Diesel motors are working and the turbines cut out, the wing propellers are turned by small electro-motors, fed by current from a dynamo driven by the centre shaft through a simple form of gearing. By this means the wing shafts revolve at a speed so regulated as substantially to reduce the loss of power from resistance that would result if they were left to turn freely. Much ingenuity, it will be gathered, has been displayed in the solution of the various problems to which this combination of turbine and Diesel propulsion gave rise.

The small cruiser "Bremse," launched at Wilhelmshaven on January 24th, deserves special notice as being the first cruising warship to have all-Diesel drive. Officially rated as a gunnery tender, she is 318ft. long, 31ft. 3in. in breadth, and displaces 1225 tons. The armament is four 4·1in. guns. Propulsion is effected by eight motors, four to a shaft, working through Vulkan reduction gearing. They are of the same design as the "Leipzig's" motors, except that an additional cylinder has been added—eight instead of seven—and the total output of the plant is 26,000 B.H.P., estimated to give a speed of 27 knots. Here, then, is a Diesel-driven cruiser of really high speed, which also possesses the advantage of a radius of action from twice to three times as great as that of a steamer of equivalent tonnage and power. The "Bremse" worthily completes a series of German post-war naval craft which deserve full recognition as examples of technical skill and, above all, of that progressive spirit in naval design which has not been conspicuous of late in certain other countries. German constructors have not been content to abide by the prevailing conventional standards which elsewhere have produced a large number of warships of painfully mediocre design. The commercial value to Germany of her pioneer work in developing the internal combustion engine, exemplified in her latest naval vessels, is too obvious to need emphasis.

Other Navies.

That British shipbuilders are second to none in originality of conception and fine workmanship is proved by the ships which they have constructed recently for foreign Governments. The six large destroyers built by Thornycrofts in 1928 for the Chilean Navy, and the three Argentine flotilla leaders launched by J. Samuel White and Co., in 1928–29, are among the finest torpedo craft produced since the war. Equally striking has been the success of Yarrow and Co. in securing contracts for the design of all the new destroyers of the Netherlands Navy. The plans submitted by this firm were chosen out of many prepared by Continental builders, and the eight vessels which have been built to the British firm's drawings have given full satisfaction. The same firm has since designed a Netherlands flotilla leader, the details of which have not yet appeared, and is also building for the Jugo-Slav Navy a leader of exceptional size and power. This vessel, to be known as the "Dubrovnik," was launched at Scotstoun on October 11th, and is 371·5ft. in length, with a beam of 35ft., and her displacement is 1880 tons. She is driven by Parsons turbines with single-reduction

* No. I. appeared January 1st.

gearing, taking steam from three Yarrow boilers, with a designed performance of 42,000 S.H.P., the contract speed being 37 knots. The armament—four 5·5in. guns, one 3·3in. A.A. gun, and six 21in. tubes—is of unusual power for a vessel of this type.

British industry has also secured a share of the Portuguese naval contracts which were placed last year. Hawthorn, Leslie and Co. are building two small turbine cruisers of 1174 tons, while Yarrows have in hand two destroyers, of 1383 tons and 36 knots.

Two coast defence ships of a novel type, built for the Finnish Navy, were launched from the Crichton-Vulcan yard at Abo—the "Vainamoinen" in December, 1930, the "Ilmarinen" on July 9th last. In effect they are sea-going monitors. The displacement is about 4000 tons. Propulsion is on the Diesel-electric system, the contract speed being 16 knots. There is 2½in. armour on the sides, reinforced by a protective deck and steel transverse bulkheads. The armament is formidable, consisting as it does of four 10in. guns, paired in turrets at bow and stern, and eight 4·7in. Q.F. It is understood that the guns, which are of a new model, have been supplied by the Bofors works in Sweden. The ships draw comparatively little water, they are designed for rapid manœuvring, and in certain conditions they might prove dangerous to any capital ships likely to be encountered in the Baltic. Finland has also built four submarines.

A fact of some significance is the large and growing number of submarines now possessed by the minor maritime States. These craft are to be found in the navies of Finland, Turkey, Jugo-Slavia, Rumania, Poland, Peru and Latvia. There are upwards of forty in the three Scandinavian fleets, and Holland has over thirty boats. Between them the secondary naval Powers possess no fewer than 148 submarines, the great majority being of post-war construction. This figure should give pause to those who treat the future of submarine warfare as if it were a question that concerned the great Powers alone. The almost universal popularity of the submarine suggests that proposals for its abolition, which it is reported are to be raised at the forthcoming Disarmament Conference, are unlikely to emerge from the stage of purely academic discussion.

Aeronautics in 1931.

No. II. (*conclusion*).*

WE continue below our review of some of the outstanding British aircraft produced during the year.

The Bristol Aeroplane Company, Ltd.—On the production side the chief item in the output of the Bristol Company's works consisted of "Bulldog" single-seater fighters. This design of machine, which has been illustrated in a previous review, has now been chosen for the equipment of ten of the thirteen single-seater squadrons in the Royal Air Force. In addition, it is a standard single-seater fighter in the service of eight other countries, including Australia, Sweden, Latvia, Estonia, Denmark, and Siam. A modified "Bulldog" machine fitted with a Bristol "Mercury" engine in place of the "Jupiter" engine was produced and gave a very high performance.

Important work on the development of structures from high-tensile steel strip was carried out, and its results, we learn, will be embodied in future Bristol designs.

A new machine produced during the year was the type 118 general purpose aeroplane illustrated herewith. This machine can be used alternatively as a two-seater fighter, bombing or photographing machine for army co-operation purposes or as an ambulance plane taking two stretcher cases. As a fighter or for army co-operation purposes it is armed with a Vickers 0·303in. gun on the port side and operated by the pilot and a 0·303in. Lewis gun on a balanced Scarff ring and operated by the gunner or observer. It carries 600 rounds of ammunition for the Vickers gun and six double drums for the Lewis gun. As a bomber it can carry in racks beneath the fuselage either sixteen 20-lb. bombs, four 112-lb., or two 250-lb. bombs. In addition, five practice bombs are carried in a crate. The gunner or observer's cockpit is situated immediately behind the pilot's cockpit. The seat in the rear cockpit can be folded up and the floor can be pushed aft on slides. In this way the observer can pass into a tunnel beneath the pilot's cockpit, in which, lying prone, he can operate the bomb release gear. From the same position he can also operate a camera. Both the bomb release gear and the camera can alternatively be controlled by the pilot. When the machine is used as an ambulance one of the stretcher cases is accommodated in the bombing station and the other in a compartment at a higher level aft of the rear cockpit. With the floor of the after cockpit pushed back the second member of the crew has ready access to both patients. For army co-operation purposes a "three-panel" wireless equipment can be stowed aft of the rear cockpit. The observer operates the continuous wave and interrupted continuous wave panels, while the pilot can operate the telegraphy panel through a system of remote controls.

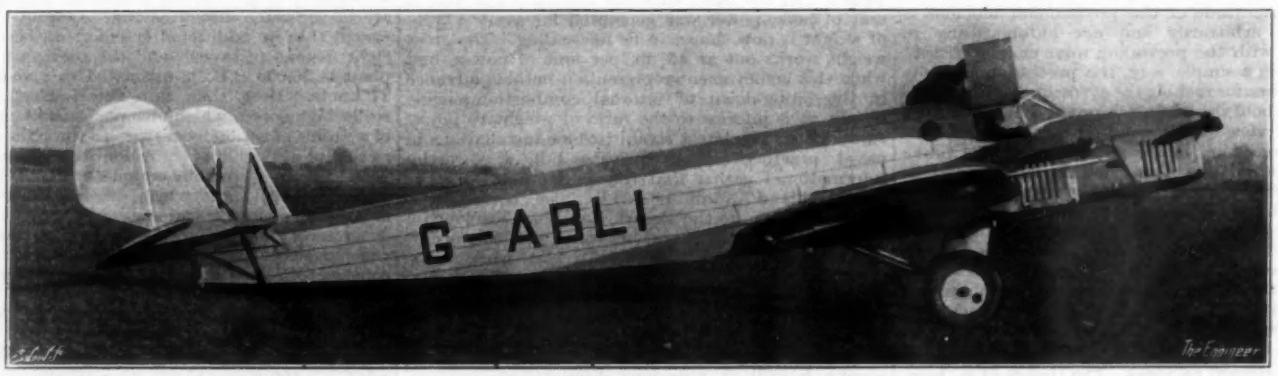
BRISTOL, TYPE 118, GENERAL PURPOSE MACHINE

The machine is driven either by a "Jupiter" X.FA or "Pegasus" engine. In each of two tanks, one at the inner end of each top wing, 50 gallons of petrol are carried. In addition, two 30-gallon tanks are housed in the top centre section. Ten gallons of oil are carried in a tank at the forward end of the fuselage. The structure of the machine is entirely of metal, principally high-tensile steel. The machine has a top wing span of 40ft. 8in. and a fully loaded weight of 5200 lb. With a "Jupiter" supercharged engine it has a ground level speed of 140 m.p.h. At 12,000ft. its speed is 165 m.p.h., and at 20,000ft. 151 m.p.h. It can climb to the last-named height in 22·1 minutes. These figures go some way towards justifying the claim made for the machine that for an aeroplane designed to fulfil a wide range of functions it has an exceptionally high performance.

In the engine department intensive development work was undertaken, chiefly in connection with the "Mercury" and "Pegasus" types of engine, both of which have now been placed in production and are available for supply. The "Jupiter" F series of engines is being continued in production, but the range is being completed by the "Mercury" IV-S2 engine and by the "Pegasus" series comprising four supercharged and four non-supercharged designs. All these new engines are of the nine-cylinder radial air-cooled type and are fitted with reduction gearing of either 0·655 or 0·5 ratio. Numerous improvements have been effected, so much so that the engines are suitable only for new aircraft and are not interchangeable with standard "Jupiter" engines already in use. In connection with the new engines, the company is producing detachable light alloy airscrew blades and hubs of the two or three-bladed form. The range includes engines suitable for driving propellers as distinct from tractor screws.

Saunders-Roe, Ltd.—At the East Cowes works of Saunders-Roe, Ltd., the principal new product of the year was the single-seater, three-engined low wing monoplane for carrying mails or freight, which is illustrated herewith. This machine is unusual, in that it is built almost entirely of wood. The framework of the fuselage and wings is of wood and the coverings of each are of plywood. The tailplane and elevators have wooden frameworks and fabric coverings. The twin rudders and fins are also covered with fabric, but their framework is of welded steel. The pilot sits in an enclosed cabin in front of the wings and behind him there is a large compartment for the mails or other freight. Three inverted "Gipsy" engines are provided, one on a steel mounting at the nose of the fuselage and two on steel structures attached to the front spar of the wings The machine has a span of 56ft., a length of 41·5ft., and a total weight of 6100 lb. It can carry fuel for six hours, together with 1000 lb. of freight. Its top speed is 130 m.p.h. and its cruising speed 110 m.p.h. The machine can climb with full load with any one of its engines cut out.

The "Saro Cloud" amphibian flying boat was produced during the year in a modified design fitted with two geared double "Mongoose" engines. This machine is fitted for navigation instruction and general service use, but it can also be supplied for civil purposes, in which category it is capable of carrying a pilot, mechanic and eight passengers or an alternative loading. The "Saro" A7 three-engined flying boat delivered to the Air Ministry in the autumn of 1930 started upon an extensive cruise to the Middle East during August. In a total flying time of 90 hours between August 15th and September 16th the machine covered an aggregate distance of 8324 miles and visited among other places, Malta, Aboukir, Port Sudan, Ismailia and Algiers. On the last day it flew non-stop from Gibraltar to Plymouth, a distance of 1230 miles, in 13 hours 40 minutes. During that stage the port engine failed about 200 miles from Plymouth, but the flight was completed on the two remaining engines. The machine is a long-range reconnaissance flying boat. During the Middle East trip it carried a crew of six and a full military load.



SAUNDERS-ROE THREE-ENGINED MAIL PLANE

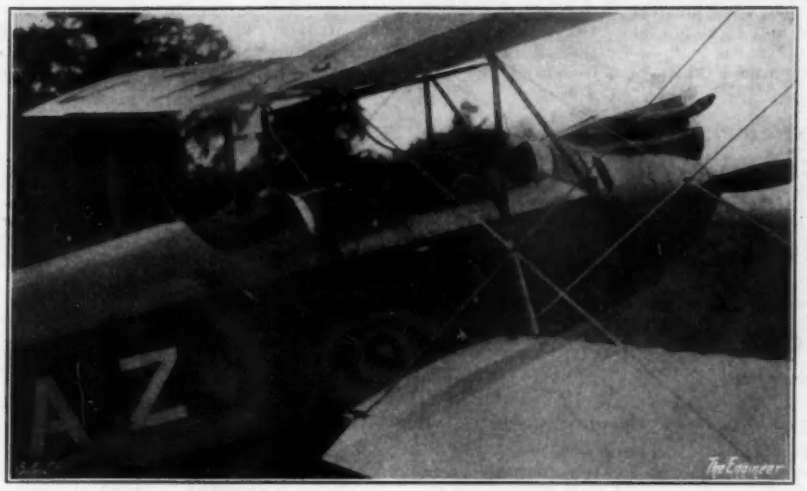
The de Havilland Aircraft Company, Ltd.—Since 1925, the de Havilland Company has produced over two thousand light aeroplanes of the "Moth" type. A year ago 1600 "Moth" machines were known to be in everyday use for military, official, private or commercial purposes throughout the world. The machines are produced in several patterns. The standard "Gipsy Moth" is driven by a 100 H.P. or 120 H.P. "Gipsy" engine, and has a wooden fuselage. It is produced in quantity at the company's Stag-lane,

* No. I. appeared January 1st.

Edgware, works. The special "Gipsy Moth" has a steel fuselage, and can be modified as regards its equipment and finish to suit the purchaser's requirements. In both forms the machine is an open-cockpit, two-seater biplane. The "Puss Moth" is a two, or occasional three, seater, high-speed touring monoplane of the cabin type. It is driven by a 120 H.P. inverted "Gipsy" engine. The latest addition to the "Moth" family is the "Tiger Moth." This machine is primarily intended to be used as a training machine for service pilots. It has been designed to embody within itself all the characteristics of the high-performance machines which those taught on it will ultimately fly. In that respect it marks a departure in the ideas previously expressed in the design of training machines. From it the pilot in training can pass straight to the high-performance service machine without passing through a period of training on an intermediate type of machine. In other words, it is designed to serve all primary, intermediate and advanced training needs. While it is safe to fly it does not err on the side of being too easy to fly. Without running a risk of serious trouble the pilot is permitted a range of error, but the controls are sensitive and do not mask the pupil's faults. The machine can be used for training in fighting, involving violent aerobatics, and for training in formation flying, reconnaissance, wireless, bombing, photography, &c. It is a two-seater with dual control and is driven by an inverted 120 H.P. "Gipsy" engine. Important features in its design are the high degree of visibility afforded from both cockpits and the ease of access to and egress from them. The after cockpit of a two-seater machine, presents no difficulties as a rule from the point of view of escape by parachute, but the front cockpit is commonly obstructed by the wings, stay wires, exhaust pipe, or other part of the machine. In the "Tiger Moth" these points have been specially considered, with the result that it is almost as easy to emerge with a parachute from the front as from the after cockpit. At the laden weight of 1643 lb., the machine has been officially tested by the Air Ministry. At sea level it was found to have a true air speed of 109 m.p.h., and a rate of climb of 700ft. per minute. At 15,000ft. its true air speed was 85·5 m.p.h. and its rate of climb 80ft. per minute. Its true stalling speed was 46·5 m.p.h. and its estimated absolute ceiling 17,000ft.

Spartan Aircraft, Ltd.—The works of Spartan Aircraft are now established at Cowes, and are primarily devoted to the construction of light aircraft for civil purposes. The company's machines are specially designed to ensure low maintenance costs. In this connection, it may be recalled, it established its position in the aeronautical world with a machine in which the wings were reversible and interchangeable, as were the ailerons, elevators and rudder. The Spartan two-seater "Arrow" has been built both as a land machine and as a seaplane, and was followed by a three-seater model which is produced as a land, sea or ski-plane. In this three-seater machine, illustrated herewith, the pilot occupies the rear cockpit. The two passengers in the front cockpit may sit both looking forward or facing each other. The machine is supplied either with a "Gipsy" or "Hermes" engine. As a land machine its top speed is 103 m.p.h. and its landing speed 44 m.p.h. It can take off in the short distance of 150 yards and land in the still shorter distance of 120 yards. It has a span of 28ft. 10in., but, with the wings folded, its width is reduced to 9ft. 8in. New designs of civil aircraft are now engaging the company's attention. One of these designs will be a three-engined cabin-type machine to seat five and the pilot. The body of this machine will be constructed of "Alclad" and the wing will be of the full cantilever monoplane pattern. Another new model, the long-range, three-engined, mail carrier, of which we give an illustration, is already in existence and flying, and after being thoroughly tested, will, it is anticipated, be placed on the market during the coming summer.

Handley Page, Ltd.—The production of no new machines with which it is permissible to deal is reported by Handley Page, Ltd. We are informed that the company has now completed its orders for the "Hinaidi" twin-engined night bombers, and that both from the military and the flying points of view the type is considered to be very efficient. The "Clive" all-metal, twin-engined troop carrier, capable of accommodating seventeen fully armed troops or of acting as a freight or petrol carrier, as a bomber or as an ambulance, was in constant service in India during the year, and was able to demonstrate its versatility. On the civil side the company completed towards the end of the year the order for eight of the four-engined air liners capable of carrying forty-two passengers, which we illustrated and described in our review a year ago. Four of the machines are of a modified "Eastern" type, for use on the Indian section of the England to India air route. The Handley Page slotted wing continued to increase its popularity throughout the world. Licences for the use of the device have now been granted in twenty-one different countries. In the Royal Air Force nineteen types of aircraft, representing 80 per cent. of the Service, are now fitted with slotted wings. The slot and interceptor device has recently been fitted to single-seater fighters, a type of machine which previously was regarded as unsuited for slotted wings because of the interference with rapidity of manœuvring which such wings were believed to produce.



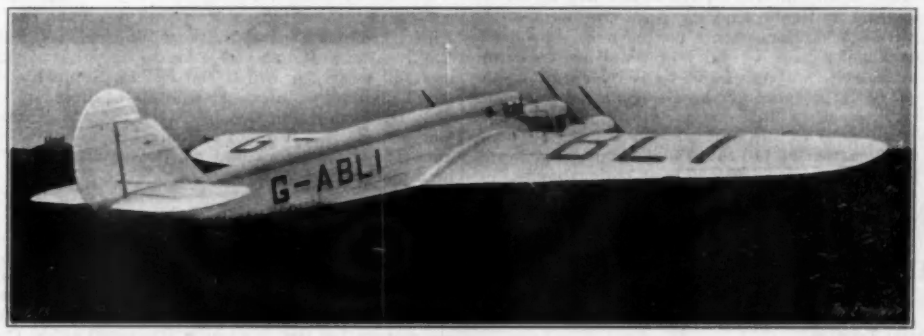
SPARTAN THREE-SEATER LIGHT AEROPLANE

H. G. Hawker Engineering Company, Ltd.—Like other British aircraft building firms, the H. G. Hawker Engineering Company, Ltd. of Kingston-on-Thames, received orders from foreign governments during the year for machines of its construction. The machines thus supplied were of the "Nimrod," "Fury," "Hart," and "Horsley" types, concerning which we have said something in previous reviews. The "Nimrod" is a single-seater fleet fighter deck landing machine driven by a Rolls-Royce "Kestrel" engine. A new type, the "Audax" Army co-operation machine, reached the production stage during the year, while yet another design, the "Osprey" two-seater fleet fighter reconnaissance machine under construction for the Fleet Air Arm, will be in service early this year. Both these new designs are driven by "Kestrel" engines. The Hawker "Hart" is claimed to be the fastest day bomber in the world. During the air manœuvres of 1931 it is said to have evaded the defending aircraft on every occasion except when it was opposed by the Hawker "Fury" interceptor fighter, a machine capable of climbing to 20,000ft. in 9¼ minutes and having a speed of 207 m.p.h. at that height. These two types of machine are now in extensive service use. In spite of their high performance, they would appear to be economical from the point of view of maintenance. They embody the Hawker patented system of construction and after 600 hours of flying under active service conditions have been found to require no structural attention beyond ordinary routine maintenance. It is believed that they will with ease reach the 1000-hour mark without requiring overhauling. The "Hart" is a two-seater day bomber. During the year it was produced as a two-seater fighter and in that form No. 23 Squadron at Kenley was equipped with it. The success achieved is stated to have been such that the "Hart" as a two-seater fighter will probably be further developed.

The Blackburn Aeroplane and Motor Company, Ltd.—No entirely new types of machine were produced during the year by the Blackburn Company, of Leeds and Brough. The company was, however, active in production, although latterly the economic difficulties compelled it to make some reduction in the numbers of those employed by it. It is, however, redoubling its efforts to increase its foreign business. In that connection it is gratifying to learn that it has secured a seven years' extension of its contract with the Greek Government under which it supervises the national aircraft factory at Athens. That factory was organised and equipped by the company in 1925 and has since been supervised by it. The company still maintains its main machine shop and one or two other departments at Leeds, but the main portion of its activities is now concentrated at Brough, on the Yorkshire coast. The production of the works during the year was chiefly concerned with a number of "Ripon" coastal defence torpedo-carrying aircraft and some flying boats for the Air Ministry. Coastal defence and light aircraft of the "Bluebird" type were supplied to Japan, fighters to China, and light aircraft to private undertakings and individuals in various parts of the world. In June the company established what is claimed to be a record by delivering to the Royal Air Force a new "Iris III." reconnaissance and coastal patrol flying boat after a period of construction covering only thirty weeks. A further contract for "Ripon" machines is now in hand and experimental work is in progress on new types of coastal defence machines and on two designs of civil aircraft. Important progress in design and production methods is reported by the factory. Extensive research work is being continued on metal construction, for which the factory is already well equipped. Since April, 1930, the track system of assembly has been practised in the factory and has shown a substantial reduction in costs and a large saving of time. Under this system the product from the early stages to the finished condition is assembled on trolleys which move along a track in accordance with a time schedule.

Airships.

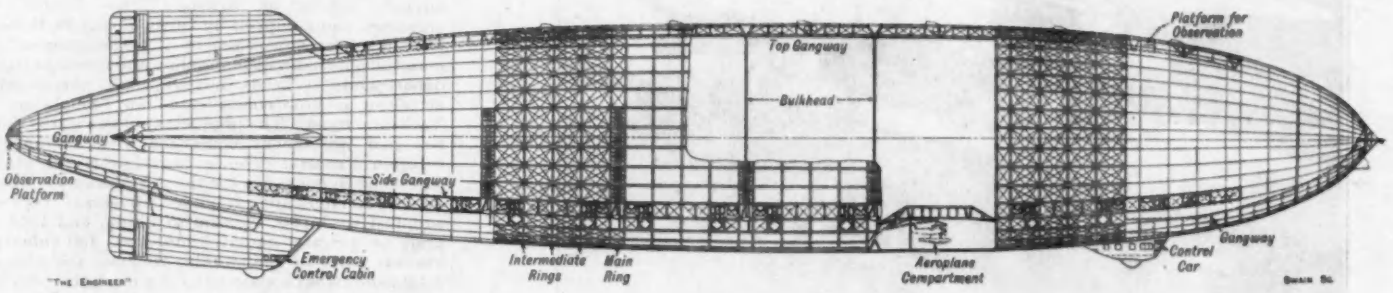
While the German airship "Graf Zeppelin" continued to carry out several successful and impressive flights to various parts of the world, British airship activity was brought to a close by the sale and dismantling of the "R 100." Sir John Simon's Committee of Inquiry into the cause of the disaster to the "R 101" reported at the end of March. It found that the disaster was not caused by structural failure of the vessel in the air. The conclusion reached was that the immediate cause of the disaster was "leakage culminating in a substantial loss of gas from one or more of the bags in the fore part of the ship." Following the issue of the report the Government announced that it intended to maintain the "R 100" as an experimental vessel and otherwise to keep in touch with the development of airships. In the autumn, however, faced with the necessity for national economy, it abandoned this intention, sold the "R 100," and took all other possible steps to terminate expenditure on airships.



SPARTAN THREE-ENGINED MAIL PLANE

In America the U.S. Navy airship "Akron" was completed, launched and successfully tested. It has now been officially accepted and commissioned by the U.S. Navy, and an order for the construction of a sister ship has been placed with the builders, the Goodyear-Zeppelin Corporation. The general arrangement drawing of the "Akron," reproduced herewith, indicates the general features of the vessel. With her twelve gas cells 95 per cent. full her total gas capacity is 6,500,000 cubic feet, giving with helium

as the gas a total lift of 403,000 lb. Her estimated empty or dead weight is 221,000 lb., so that her useful lift, including the weight of the crew, food, fresh water, water ballast, fuel, oil, reserve cooling water, spare parts and military equipment, amounts to 182,000 lb. The power plant consists of eight Maybach petrol engines, each developing 560 H.P. at sea level. The estimated maximum speed at an altitude of 3000ft. is 84 m.p.h. Her normal fuel capacity is 124,000 lb., or 70 per cent. of the useful lift, and at the maximum speed is sufficient, it is estimated, to give the vessel a still air range of 4800 nautical miles. The normal crew consists of thirty-eight men and ten officers, excluding the pilots for the aeroplanes which the vessel is designed to carry. The framework is carried out principally in duralumin of the Aluminium Company of America's manufacture. This material after heat-treatment and ageing was cold-rolled to raise its yield point from the normal value of 30,000 lb. per square inch to 42,000 lb., the tensile strength of 55,000 lb. being unaffected by the process. The stay wires are of hard steel having a tensile strength of from 220,000 lb. to 240,000 lb. per square



THE U.S. NAVY AIRSHIP "AKRON"

inch. The framework is covered with cotton cloth. Protection of the duralumin parts against corrosion is secured by anodic treatment, followed by a coating of varnish pigmented with aluminium. The wires were galvanised before the final drawing operation, and other steel parts were cadmium or zinc-plated.

The Maybach engines weigh nearly 4·5 lb. per horse-power in the dry state, but, included in this figure, is the weight of a compressed air starting and reversing gear. The engines are housed in rooms inside the hull, a feature rendered possible by the use of helium as the source of buoyancy. They are placed athwartships and each drives a 16ft. transverse shaft, at the end of which there is a short propeller shaft which can be tilted from the horizontal downwards through 90 deg. There is a speed reduction from 1600 r.p.m. at the engines to 925 r.p.m. at the propellers incorporated in the drive. Combined with the reversibility of the engines the tilting of the propellers enables a thrust to be developed in the ahead, astern, upward or downward direction. The upward thrust amounts to about 6000 lb. and the downward to about 8000 lb. The propellers are of wood and are two-bladed with a diameter of about 16ft. 4in. In order to avoid valving the helium as the the fuel is consumed, arrangements are made for condensing and collecting the water contents of the exhaust. A similar scheme has been in use on the "Los Angeles" for several years, and recovers from the exhaust as water from 95 to 105 per cent. of the weight of the fuel consumed. The condensing arrangements consist of five panels of aluminium tubes mounted close to the hull above each engine. The petrol is carried in 110 tanks and about 30 per cent. of it can be quickly jettisoned in an emergency.

Electrical Engineering in 1931.

No. II. (*conclusion*).*

Electric Traction.

APART from the work that is being done on the London–Brighton line and the Barking–Upminster line of the Southern and L.M.S. railways respectively and on the London Electric railways, a certain amount of traction equipment was built for abroad. The English Electric Company completed the electrification of the Madras Suburban lines of the South Indian Railway. A double track for the electric trains was constructed from Madras to Tambaram, a distance of 18½ miles, and certain shunting yards in the neighbourhood of Madras were electrified. The English Electric contract covered the whole of the rolling stock, which was constructed to the specification and under the supervision of the railway company's consulting engineers, Robert White and Partners. The new lines were opened on April 2nd, 1931, by his Excellency the Governor of Madras, and the public services began during the following month. Another interesting foreign order was that secured by the Metropolitan-Vickers Electrical Company from the Hungarian State Railways for thirty-six passenger and goods locomotives for service on the main line between Hegyeshalom and Budapest. They are to operate on the "Kando" system, which enables single-phase, 16,000-volt, 50-cycle current to be collected from the overhead wire, whilst on the locomotive the single-phase current is converted into polyphase current, and is supplied to a polyphase motor at a suitable voltage. Up to the present, work has been done on the equipment of four locomotives, and it is the intention of the Hungarian State Railway authorities to test them under service conditions before the work on the remainder of the engines is proceeded with. The first four engines should be in service by March, and the work on the other thirty-two engines should begin soon afterwards.

A new traction motor, having a one-hour rating of 300 H.P. at 575 r.p.m. was developed by the Metropolitan-Vickers Electrical Company for D.C. railways. Intended for express service, this totally enclosed motor is of novel design, and by making full use of the natural ventilation due to the speed of the motor coaches, it has been possible considerably to reduce the weight and to give a relatively low temperature rise. An order was secured by the same firm from the Great Southern Railways of Ireland for the complete electrical equipment for two motor coaches, to form the first experimental train to test out the Drumm battery under actual service conditions. The B.T.H. Company is also manufacturing electrical equipments for battery train units for operation on the Great Southern Railways of Ireland. Thirty-eight Metro-Vick 255 H.P. traction motors were ordered for the Bilbao–Portugalete Railway, which forms a section of the large schemes of railway electrification which are gradually being put into operation in Spain.

For use at the Dagenham works of the Ford Motor Company, the B.T.H. Company secured an order for three oil-electric locomotives, each weighing approximately 40 tons. The locomotives are for hauling hot metal ladles and slag ladles, having a total weight up to 200 tons. They are also to be used for ordinary goods shunting with trailing loads up to a maximum of 400 tons. Despite the opinion that is now often expressed that electric tramcars are obsolete, both the English Electric Company and the Metropolitan-Vickers Electrical Company seem to have secured some quite good orders for tramcar equipments. Some electrical firms also seem to have experienced a fair demand for electric trolley omnibus equipments.

Two electrification schemes using G.E.C. equipment were put into service during the year, the Buenos Aires Terminal Central Railway and the L.M.S. and L.N.E. Joint Manchester–Altrincham line working at 1500 volts, for which the B.T.H. Company also supplied equipment. The G.E.C. supplied two 550 H.P. shunting locomotives to the Chinese Engineering and Mining Company, and many railway and tramway motors and control equipments were manufactured at Witton.

Water Power Plant.

All the large electrical manufacturers built a certain amount of water-wheel generating plant. From Balfour, Beatty and Co., the B.T.H. Company received an order for two water-wheel horizontal alternators for the Grampian Electric Supply Company's Tummel power station. Each machine will develop 21,250 kVA when running at 300 r.p.m., and will generate 11/13,000-volt, three-phase, 50-cycle current. Another order awarded to the B.T.H. Company by Balfour, Beatty was for two horizontal water-wheel driven alternators for the East African Power and Lighting Company, Ltd. Each of these three-phase machines is rated at 2500 kVA, 11,000 volts, 50 cycles, and runs at 600 r.p.m. During the year the company built four three-phase water-wheel alternators, rated at 13,333 kVA, 11,000 volts, 50 cycles, and 428 r.p.m., for the Uhl River Hydro-Electric Scheme. Two of these machines are on the way to their destination; the other two will be despatched at an early date. A complete 6000 H.P. water reaction turbine, with alternator and cylindrical balanced valves, was built by the English Electric Company for the Kurra Falls power station of the Nigerian Electricity Corporation. A 12,650 H.P. English Electric reaction turbine and alternator were set to work at Lake Coleridge, New Zealand; two 7250 H.P. sets were put into service in the Shannon River power station, Tasmania; and two 2650 H.P. reaction turbines for working under a head of 429ft., and designed for 1000 r.p.m., are being built for the St. John Del Rey Mining Company, of South America. The machines are being supplied complete with alternator, stream-line cylindrical balanced valves, oil pressure governors, &c.

Two vertical, 12,500-kVA, 250 r.p.m. water-wheel alternators were installed by the Metropolitan-Vickers Electrical Company in the new semi-automatic station at Gavet, Spain, and the new turbines operate in series with the previously existing turbines at the Tremp station. Three 7800-kVA, 600 r.p.m. Metro-Vick horizontal water-wheel alternators were sent to Madras for installation at Pykara.

Research.

Important work was done by the British Electrical and Allied Industries Research Association on improved methods of circuit breaking, and a strong patent situation is being built up in spite of active opposition by competitors. A new form of baffle attachment developed and tested during the year will enable the rupturing capacity of existing circuit breakers to be materially increased without increase of overall dimensions. The device is expected to prove of great service to engineers who find that the growth of their plant has given rise to a heavier demand on their switchgear, and who, in the absence of this new device, would have to undertake expensive and difficult reconstructions. The study of transient phenomena of circuit breaking was continued to advantage, and additional important contributions were made to the fundamental knowledge of the phenomena of circuit breaking. In connection with the work on the properties of steam at high temperatures and pressures the investigators are preparing important contributions for the next meeting of the Steam Table Conference. The International Union of Physics has agreed to a definition of the kilocalorie in conformity with the recommendations of the Conference.

Promising advances were made in researches on wind pressure on overhead lines, the heating of cables, including those in ducts and the study of cable armouring and armouring losses. Work on the heating of cables in racks was carried to a useful stage. Some advance was also made in the study of vibration on overhead lines. The study of moisture movements in the soil proved very complicated, but definite results are being obtained. The critical study of the use and manufacture of concrete poles is also yielding useful results. Problems connected with earth connections, earth currents and particularly the flow of A.C. in the earth and interference with communication circuits received continuous attention, and important reports have been issued or are in preparation. New researches were planned for the benefit of railway engineers. Variation of consumers' voltage received close attention and important researches in this connection were arranged. The phenomena of surges on transmission lines also received continuous attention.

In the B.T.H. research laboratories much work was done on the development of industrial vacuum electrical devices, including thin film caesium photocells for sound films, lamp photometry, and other electrical uses, and hot cathode mercury vapour rectifiers and thyratrons. The hot cathode mercury vapour rectifiers offer an efficient means of obtaining D.C. from A.C. systems. Large cathodes giving high electron emissions can easily be incorporated in compact bulbs capable of rectifying at high voltages, the voltage drop being low and constant, *i.e.*, in the neighbourhood of 10 volts.

A special rectifying valve introduced during the year will deliver 6 ampères D.C. at 300 volts, and is therefore suitable for charging standby cinema batteries, &c., and also for supplying the current necessary for small arcs. The overall height of the valve is 7in. It is fitted with a cathode of the internally heated and heat shielded type, and is capable of delivering a peak current of 25 ampères with an input of only 50 watts.

A self-contained photo-electric relay developed in the B.T.H. laboratories embodies a photo-cell amplifier and small contactor housed in an aluminium alloy waterproof case. It can be operated off any standard A.C. or D.C. lighting supply, and can be arranged to open or close a circuit with change of illumination.

Throughout the year steady progress was made in all sections of the Metropolitan-Vickers research labora-

* No. I. appeared January 1st.

tories, but we must confine attention to one or two electric and magnetic investigations. Apparatus for directly measuring the load losses of large A.C. machines under very low power factor conditions, was completed and put into service. The apparatus is capable of dealing with 100,000 kVA at 11,000 volts. Noise problems associated with A.C. and D.C. motors were continued with a view to cheapening construction without sacrificing quiet running properties. In connection with switchgear, investigations were made on the heating of structural steel adjacent to conductors carrying heavy currents with a view to providing design rules for avoiding local overheating in such parts. Work was also done on various types of contacts and on special bus-bar sections. A fairly complete theoretical and experimental investigation was completed on the design of high-pressure voltmeters and synchronising equipments operated through condenser terminals. Considerable attention was paid to experimental work on oil circuit-breaker problems, and the cooling of transformers. The company's research engineers' work on core losses was completed. A somewhat extensive investigation on the shielded type of reactor was carried out and work on reactors of other types is in hand. Other transformer subjects dealt with included transient voltage distribution in the windings, the effect of magnetic fields on the performance of precision current transformers, the design of Petersen coils, and some acoustical problems on transformers. A precision turn testing apparatus made for the transformer department enables the exact number of turns of a coil up to 3000 turns to be rapidly determined. An electrical apparatus was also made for checking the accuracy of turbine gears.

The research engineers of the Wembley laboratories of the General Electric Company devoted their attentions to a wide range of problems bearing upon electrical science and manufacture, including the development and testing of aviation lighting equipment. A reflector type air beacon was developed, and the beam candle-power tests have checked out well with the calculated performance. An aerodrome flood-light equipped with parabolic trough reflectors and 1000-watt tubular lamps was produced. New designs of prismatic reflector for street lighting and other purposes were evolved. Improvements in prisms are said to have raised the efficiency of these reflectors to a high level. The diffusion of light by optical glass was given further attention and the theoretical work of Ryde and Cooper was used to develop a practical test schedule for optical glass fittings, which enables their efficiency as lighting units to be determined, together with the quality of the optical glass as a diffuser.

A photo-electric photometer utilising a cubicle photometric integrator and having a direct reading lumen scale was installed at the Osram Works, Hammersmith, where it is used for measurements on very large lamps up to the 10 kW lighthouse size.

The manufacture of special glasses for sodium vapour discharge tubes involved the provision of suitable pots for melting the glasses, and it was found necessary to develop special types of refractory porcelain for the purpose. New types of coloured tubing were also made for use in neon signs.

Wireless Communication.

Experimental work on ultra-short waves, particularly those of the quasi-optical type, aroused much interest in wireless circles. In November, Marconi, using a wave length of 50 cm., gave a demonstration in Italy between Santa Margherita Ligure and La Spezia, a distance of 25 miles, whilst, in the early part of the year the International Telephone and Telegraph laboratories of Hendon gave a demonstration of the use of 18 cm. waves between Dover and Calais. For the use of the B.B.C. in the study of these exceptionally short waves for broadcasting, the Marconi Company is at present constructing an ultra-short wave transmitter, although, according to reports, there is little likelihood of ultra-short waves superseding those now in use for general broadcasting, and of existing receivers becoming obsolete. Broadcasting continued to increase in popularity throughout the world, and one of the most important stations opened during 1931 was that of 158 kW at Warsaw, the most advanced station of the kind at present in operation. Many of the difficulties of selectivity in broadcast receivers have been solved by the use of band pass filters. High-power transmitting valves up to 500 kW have been developed, while on the receiving side the variable, "mu" valves which eliminate the drawbacks of the ordinary screened grid valve, have been introduced with marked success.

While progress continued in the field of television, a good deal of work would appear to be necessary before television receiving sets will be as widely used as ordinary wireless receivers. Further progress was also made with facsimile picture transmission, and considerable attention was paid to atmospheric phenomena, which, to a certain extent, impose limits on the speed of transmission.

As regards the use of wireless at sea, the process of modernising ships' stations in conformity with the recommendations of the Washington Convention, is progressing as new ships are equipped, and I.C.W. and C.W. transmitters are being fitted instead of spark transmitters in all new ships. Wireless telephony apparatus was fitted on several large ships, such as the "Empress of Britain" and the "Monarch of Bermuda." A wireless telephone installation was established at the Coast Wireless Station at Wick, in the North of Scotland, and like the Humber Wireless Telephone Station, it is for the use of trawlers and fishing boats fitted with the necessary wireless equipment. The Fishguard station is being adapted for the same purpose, and with these added facilities more trawlers are being fitted with wireless apparatus. Full advantage was taken of the Faraday Exhibition, held at the Royal Albert Hall, to bring to public notice the developments of wireless communication since the days of Marconi's early experiments, and the display of the original apparatus and of some of the most up-to-date equipment used to-day attracted considerable attention.

Post Office Wireless Work.

The development of the use of short waves for continental communications was continued by the bringing into use of a new short-wave transmitter housed in a building at the Leafield Station. Another transmitter of an experimental type is in course of construction. Both these transmitters incorporate the latest developments of crystal control and have a constancy of frequency well within the limits laid down at the recent meeting of the C.C.I.R., held at Copenhagen in May and June of 1931.

A further development was the entire elimination of electro-mechanical relays from the keying system, this being done entirely thermionically, by means of a thermionic trigger relay developed in the Post Office Engineering Department. The system has proved highly satisfactory in operation and is being adopted as standard for future transmitters. Greater use has also been made of directional arrays or "beam aerials" at the above station, whilst, at the corresponding receiving station at St. Albans, additional high-grade receivers for use on short waves have also been installed for use on these continental services. These are of the super-heterodyne type having very considerable amplification and good selectivity, and are provided with limiters arranged to reduce the effects of fading. They were supplied to Post Office specification by Marconi's Wireless Telegraph Company, Ltd.

The coast station at Wick was converted from spark to I.C.W. transmission, and similar work is well in hand at the Land's End Coast Station. At the Rugby Radio Station two new short-wave transmitters were completed, one of which has been put into commercial service for the direct London-Argentina-Brazil circuit. This transmitter will also be used to work to South Africa during the morning period. It was supplied to the Post Office by the Standard Telephones and Cables Company, Ltd., Hendon. The second transmitter will be used for the direct service to Canada during the afternoon and evening periods, while during the morning periods it is proposed to use it for working to Egypt, for the business hours in the respective countries will enable this economical use of transmitters and receivers to be made. Corresponding high-grade receivers have been installed at Baldock, the central receiving station.

A long-wave receiver for use as a standby for the receiving station at Cupar, in Scotland, has also been supplied by Marconi's Company to Post Office specification. It is fed from an aerial system of Post Office design consisting of an array of combined loops and vertical aerials, which are lined up to be strongly directional on the U.S.A., and to have a very good back end balance, so as to reduce interference to a minimum.

Full advantage has been taken during the year of the recent advances that have been made in high-power valve design. The long-wave Rugby telephone transmitter was re-designed to make use of 100-kW valves developed in the research laboratories of the General Electric Company at Wembley. The bank of thirty 10-kW valves has been replaced by three 100-kW valves, and the new arrangement can also be used to give double the power output of the old set by using six of these valves in parallel. Experiments are also in progress using the new demountable valve recently developed by the Metropolitan-Vickers Electrical Company, Ltd.

Privacy apparatus was provided for all short-wave channels, and a simple addition to this system has been introduced by the Post Office, which considerably improves the degree of privacy obtained.

A large number of broadcasts were made over the Post Office radio telephone links, especially to America. Experimental work was continued on the ultra-short wave lengths. The future of these wave lengths is expected to lie in their use over short distances in the place of short lengths of submarine cable used at present.

Miscellaneous.

Despite the bad times, any attempt to describe the electrical work done during the course of the past twelve months must fall a long way short of actualities, but an endeavour will now be made to give a general idea of some of the outstanding activities apart from those mentioned under the various classified headings. There was decided progress in the production of mercury arc rectifiers. A B.T.H. 1500-kW, 1500-volt rectifier was put into service on the Manchester-Altrincham line, the second rectifier employed for heavy electric traction service in this country. At the moment there are seventeen 1500-kW and five 2000-kW rectifiers under construction in the Rugby works for the London Electric Railway Company, and two 1200-kW units for the L.M.S. Barking to Upminster electrification scheme. The General Electric Company, of Witton, Birmingham, is also constructing thirteen 1500-kW rectifiers and two of 12,000 kW, all for heavy electric railway service. Bruce Peebles, who are working under licence to Brown, Boveri, are installing rectifiers at Harrow and Hull, and are making the transformers for the Brown-Boveri rectifiers that are to be installed in the eighteen sub-stations on the London to Brighton line. During the year Bruce Peebles and Co., Limited, installed rectifiers at Sheffield, Lincoln, Bradford, Newcastle-upon-Tyne, Gateshead-on-Tyne, and at Bolton.

As regards electric motors, there was an increased demand for unity or leading power factor machines, which are replacing some of the older types of motors in factories that have been re-equipped under the frequency standardisation scheme. It is becoming common practice, states the English Electric Company, to include one or more "Kosfi" motors in a new installation in order to qualify for the maximum bonus in respect of high power factor, where an inducement of this kind is offered by the supply company. No-lag B.T.H. motors have been frequently used in the same way. Similarly, it has apparently been found by firms making A.C variable-speed commutator motors that these machines are meeting with increasing favour for driving such things as ventilating fans, passenger lifts, pumps, &c., and needless to say the demand has been increased by the many change-overs from D.C to A.C. The total capacity of B.T.H. A.C. variable-speed commutator machines is said to be 50,000 H.P.

Another outstanding motor made in slightly modified forms by most electrical firms is the totally-enclosed ventilated machine, which seems to be meeting with rapidly increasing favour in places where the windings of motors must be protected from dirty atmospheres. The introduction of a range of frame-cooled motors, has, according to the General Electric Company, overcome difficulties hitherto associated with totally enclosed motors, which had to be of excessive dimensions if more than small quantities of power were required. The method of ventilating frame-cooled motors involves the use of a shell with a double wall casing, and the annular space between the walls is divided into sections by longitudinal ribs to form ventilating ducts, which are arranged to give two separate circuits for internal and external air flow, adjacent ducts being in different circuits. Air is blown round the internal circuit by a fan at the driving end, whilst a second fan forces a continual flow of cool air through the adjacent external ducts. Hence, the heat is transferred from the totally enclosed part of the motor to the external ducts, and is carried away.

Dual frequency or re-connect motors, which are designed to meet the requirements of new power users who are likely to have the frequency of their supply changed, have been installed in a fair number of factories. Where the frequency of supply is liable to be increased from 25 to 50 cycles, the number of poles on these motors is doubled when the change is brought about. When a change from 40 to 50 cycles is involved, the advantage of the dual frequency motor is less pronounced, because there are few speeds common to the old and new frequency.

New large induction motors replaced the original 25-cycle machines in various works in the North-East Coast district; the Clyde Valley district, and in Birmingham. The largest induction motors supplied by the Metropolitan-Vickers Electrical Company during the year were three 5000 H.P. machines for a rolling-mill motor-generator set. A 7500 H.P., 500 r.p.m., synchronous motor, with a peak load rating of 25,000 H.P., was supplied for another rolling mill job. Synchronous induction machines continued to be called for, and four 600 H.P. motors of this type were supplied by the Metropolitan-Vickers Electrical Company to the Grimsby Ice Company for coupling to compressors.

Three 40/50-cycle Metro-Vick frequency changers were supplied to the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board. One rated at 7500 kVA was installed at the Hartshead station and two of 3750 at the Tame Valley station. According to the Metropolitan-Vickers Electrical Company, the business of re-equipping textile mills steadily improved during the year, and the company was engaged on various schemes for re-organising and equipping mills with motor installations. The amount of work this company did in the way of electrifying industrial establishments is surprising in view of the financial situation. Of the orders for electric winders, one was for a third equipment for the North Broken Hill Mining Company, New South Wales, Australia, and there were several orders from South America, one of which is for a motor-generator equipment for a winder which comprises a 5000 H.P. induction motor capable of exercising a pull out torque of four times full load. The motor drives two D.C. generators, each rated at 2000 kW. Orders for a large number of small A.C. motor winders also arrived from abroad, one of which was for fourteen of these equipments. During the year no fewer than nine large Ward-Leonard winder

equipments went through the Metro-Vick shops, and a very fair amount of rolling mill work was also carried out, for although the orders from home steel works were few, the company received a fair share of the work.

A 4500/11,250 H.P., 375 r.p.m. B.T.H. induction motor was supplied for driving a four-stand continuous rolling mill, and a 300/600 H.P., 250/500 r.p.m., 450-volt D.C. B.T.H. motor will shortly be put into service for driving a sizing mill for large tubes. This rolling mill drive is unusual, in that it is a reversing drive operating from a constant D.C. supply, the supply system being suitable for giving the current without the intervention of a Ward Leonard equipment. The motor will be controlled by a master controller and a rheostat, which will control the speed between 250 and 500 r.p.m., whilst the master controller will be used for starting, stopping and reversing. Special field relays are to be provided for the control of the acceleration with a weakened field. Other B.T.H. activities in the industrial field covered control gear for a D.C. motor driving a skip hoist of a blast-furnace, electrical equipments for excavators, and the electrical driving of paper machines. For the driving of the works of the St. Anne's Board Mill Company, Ltd., of Bristol, the company supplied 200 variable-speed A.C. commutator motors, nine "no-lag" power factor correction motors, and some forty-five induction motors ranging from 5 to 100 H.P., all provided with B.T.H. control gear.

Among the heavy plant supplied for industrial purposes by the English Electric Company was a 500/1400 H.P., 100/150 r.p.m. motor, built for a 16in. rolling mill in the works of the Motherwell Iron and Steel Company. The machine was built for direct coupling to an existing fly-wheel, and was supplied complete with contactor starting and control gear. The contract also included a 300/700 H.P., 130/260 r.p.m. D.C. motor for driving a 10in. roughing mill; a 500/1400 H.P., 150/300 r.p.m. motor, direct coupled without a fly-wheel to a 10in. finishing mill and rope driving on to hard rolls; and a 300 H.P., 270/350 r.p.m. D.C. motor, for driving an 8in. mill. The contract also included switchgear and transformers. A 2500 H.P., 3000-volt English Electric induction motor was supplied to Colvilles, Ltd., for driving a fly-wheel set belonging to the large reversing mill equipment. Other electrical rolling mill equipment was built for works in this country and abroad. For South Africa an important order was received for the supply of the main electrical equipment required by the South African Iron and Steel Industrial Corporation for its mills at Pretoria. The order covers the supply of electric motors, &c., with an aggregtae capacity of 86,000 horse-power with twelve transformers aggregating 20,000 kVA and twelve switchboards, comprising over 90 panels.

Among the English Electric orders for electric winding plant was one from the Ocean Coal Company, Ltd., for a three-phase winder to deal with an output of 156 tons per hour or 2–6 tons per wind from a depth of 601 yards, the peak horse-power of the motor being 2700 at a synchronous speed of 375 r.p.m. Other orders for winding plant were from the Hartley Main Collieries, Ltd., the Hazlerigg and Burradon Coal Company, and the Cowper Coal Company.

Needless to say, the electrical manufacturers turned out a great deal of high-capacity switchgear, which we shall not attempt to consider in detail. The development of the National "Grid" Scheme continues to demand many extensions and reconstructions of switchgear, in order to allow for interconnection with the various sections of the grid system. The English Electric Company reports that of all its departments, the switchgear department was probably the most active, whilst the Metropolitan-Vickers Electrical Company states that during 1931 it received more orders for extra high-voltage switchgear than in any previous year. The information that has reached us about switchgear contracts would fill several of our columns.

Physical and Optical Societies' Exhibition.

No. I.

APART from organisations engaged in some way or other in scientific work and individuals showing apparatus of their own design, some eighty manufacturing firms were represented at the Physical and Optical Societies' Exhibition held at the Imperial College of Science and Technology from Tuesday to Thursday, of this week. Many of these firms usually take part in this instructive show, which is always well patronised during the short period of its existence. The electrical side, which seems to extend more and more each year, invariably arouses considerable interest and presents apparatus which, if not absolutely new, is at least of recent origin. Since the show was first organised some twenty-two years ago, it has greatly increased in magnitude and importance, and in these days the Exhibition catalogue is quite an extensive publication. The introduction of wireless telephony, coupled with the modern uses of electricity, has widened the scope and increased the public appeal. Wireless, television and similar exhibits no doubt attract people who are not strictly scientific, but who have nevertheless become interested in scientific affairs as the result of broadcasting and kindred developments. Still, in the main the Exhibition retains its professional character and is regularly attended by some of this country's most prominent scientific men.

The demand for space this year seems to have been greater than ever, and two electric furnace firms were showing their goods in the basement, which, so far as we can remember, has never been utilised before. In accordance with custom there were three lectures on the three days the Exhibition remained open, the lecturers being Mr. C. C. Patterson, Mr. T. Smith, and Sir Oliver Lodge, who dealt with "Photoelectric Cells," "Photographic Shutters and their Properties," and "Reminiscences" respectively. As on the previous occasions, with the object of encouraging craftsmanship in the scientific instrument trade, a section of the Exhibition was devoted to the work of apprentices and learners in competition, and prizes were awarded to lads whose work was of outstanding merit.

Among other things, the research laboratories of the General Electric Company were showing an experimental photo-electric device for the measurement and recording of smoke densities in a factory chimney. The method consists in recording the percentage of light absorbed by the smoke in a beam of light projected across the chimney from a standard light source. The circuit used is a variation of the now well-known G.E.C. photo-cell circuit with a Cambridge recording meter in the anode circuit of the valve, an arrangement which gives a measure of density much finer than is required in practice, since it is usual to gauge smoke on the Ringelmann scale of densities, which has five steps only, viz., clear, 25 per cent., 50 per cent., 75 per cent. absorption, and black. A relay can also be arranged to give an additional alarm when the density exceeds some particular value. Very little trouble has been experienced with dust collecting on the lens, as each morning when the chimney is clear and the operator is rewinding the recorder and fitting a new chart, he adjusts a resistance in series with the lamp, thus correcting for the absorption of light due to the dust.

The Cambridge Instrument Company, Ltd., had, as usual, a good display of electrical and other instruments. Important advances have been made by the company in the design of reliable and accurate instruments for the automatic regulation of temperature, humidity, pressure, and other conditions in industrial processes. Apparatus for these purposes has been shown at previous Exhibitions, but, owing to the small

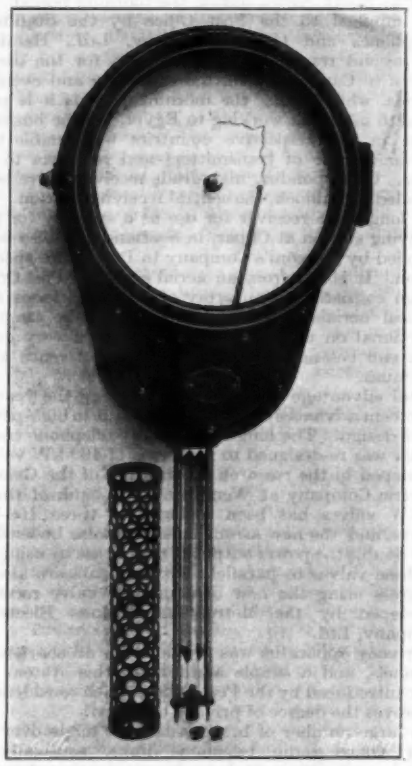


FIG. 1—CAMBRIDGE HUMIDITY RECORDER

amount of current with which the regulator itself has been capable of dealing, in the majority of cases these regulators have necessitated the use of separate relays between the sensitive measuring instrument and the circuit breaker or valve gear. But instruments were shown on this occasion which are capable of making or breaking electric currents up to 10 ampères at 250 volts, *i.e.*, currents sufficient to operate switches or motor-driven valves without the use of an intermediate relay. The instruments are arranged to work upon the potentiometric principle, a galvanometer being incorporated as the sensitive detecting element. This galvanometer may be connected to a thermo-couple, resistance thermometer, Féry pyrometer telescope, or other suitable electrical device, whereby the temperature or other condition to be controlled is measured. The exact reading at which control is desired is arranged to correspond with the zero or "balanced" position of the galvanometer pointer, and any variation from this reading will cause a deflection of the pointer. By means of a mechanism operated by a continuously running motor, the galvanometer deflection is caused to operate a mercury switch, thus opening or closing an electric circuit controlling the supply of heat, &c.

The instrument shown in Fig. 1 has been introduced by the Cambridge Instrument Company to provide direct records of the percentage humidity of the atmosphere in rooms, and is particularly suitable for use in connection with the manufacture and storage of textiles, paper, tobacco and other products which may require definite conditions of humidity for effective working or preservation. The humidity records are not affected by changes in temperature over a wide range, and, since the instrument will work efficiently

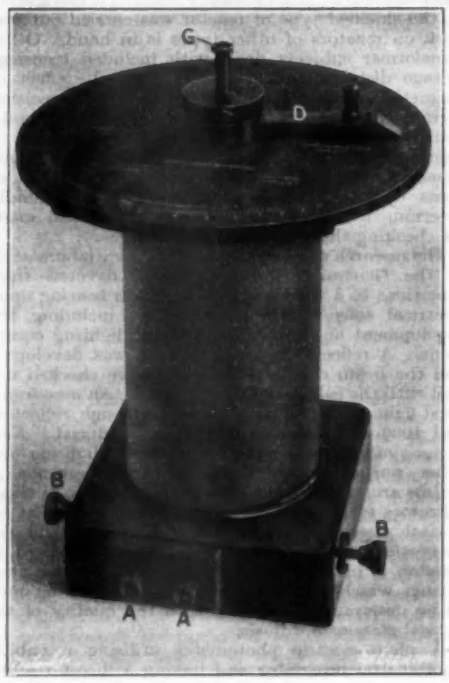


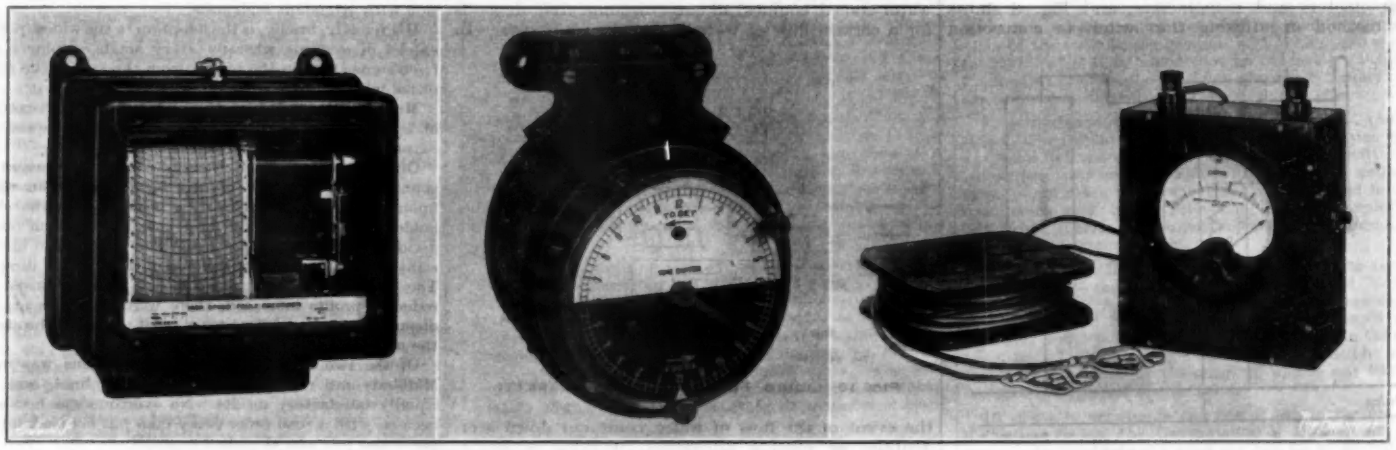
FIG. 2—MOULLIN VARIABLE CONDENSER

at temperatures below zero, it is useful for recording variations in the humidity in freezing chambers, refrigerating rooms, and cold stores. An interesting application is the recording of the humidity in the fan chambers of large pipe organs in cathedrals, churches, cinemas and public halls. The recorder depends for its action upon gold beater's skin, which varies in length with the hygrometric state of the surrounding atmosphere, these variations being accurately repeatable if the skin is maintained under certain conditions of load. Two strips of goldbeater's skin, held under tension, are exposed to the air in the position where it is desired to measure the humidity, and when the strips alter in length owing to changes in humidity, the movement is communicated through a link mechanism to a pen which moves over a circular chart, 9½in. in diameter. The chart is calibrated to read directly in terms of relative humidity—usually from 30 to 100 per cent.—and is rotated by clockwork to make one revolution in twenty-four hours. Alternatively, the chart may be arranged to run for seven days. The illustration shows the complete apparatus, with the perforated cover removed from the measuring unit to show the strips of goldbeater's skin. A similar instrument, fitted with two pens, can be supplied to give simultaneous records of both temperature and humidity on one chart.

The Moullin variable condenser shown in Fig. 2, another of the Cambridge Instrument Company's exhibits, is arranged to give very small capacity changes over a range of 45 $\mu\mu$F, and has a very open scale, which can be read with great accuracy, The scale is calibrated between 0 and 16 $\mu\mu$F, the zero reading corresponding to a residual capacity about 30 $\mu\mu$F, and by means of two switches B B two extra capacities each slightly less than the full range of the scale of the instrument, can be added, giving the instrument a possible range over about 50 $\mu\mu$F. The condenser consists of an outer fixed circular cylinder and an inner moving one, free to rotate on an axis excentric but parallel to both cylinders, so that as the inner cylinder is rotated its distance from the outer cylinder varies and the capacity of the system changes. The scale of the instrument can be calculated with great accuracy. When the two cylinders are connected together, the instrument acts as a very small variable inductance. Connection to the condenser is made by the two terminals A A at the base of the instrument. The two extra capacities are added by pulling out the

switches B B on each side of the base. The capacity is varied by rotating the arm D, which revolves the inner cylinder. The pointer D at the end of the arm moves over the scale and indicates the capacity employed. On pressing in the knob G, the two cylinders are short circuited, and the instrument can be used as a very small variable inductance. The residual inductance, when the instrument is used as a capacity, is only 0·04 μ H.

Some new electrical instruments which had never been exhibited before were shown by Everett, Edgcumbe, Ltd., of Colindale Works, Hendon. One of these instruments was the fault grapher shown in Fig. 3, which has been developed to indicate the exact moment a fault occurs, to give a graphic record of its development, progress and disappearance, together with a record of those repercussions which unfortunately often follow within a short time of the clearing of the original fault. The normal



FIGS. 3 TO 5—FAULT RECORDER, TIME SWITCH AND CONDUIT TESTER—EVERETT, EDGCUMBE

graphic voltmeter with a chart speed of, say, 1in. per hour, is useless for the purpose, and to keep a chart constantly running at a sufficiently high speed to be of value is impossible. Hence under normal conditions the chart speed in the Everett Edgcumbe fault "grapher," is 1in. per hour, and at this speed the instrument serves as an ordinary graphic voltmeter. But on the occurrence of a fault, the chart speed is increased within a small fraction of a second to ¼in. per second, and it continues to travel at that speed as long as the fault persists, and returns to the original speed of 1in. per hour when the fault has cleared. These "graphers," which are of the makers' well-known inkwell pattern, are made with single, double, or triple movements. The high-speed chart drive is entirely independent of the voltage, and even in the event of the supply failing, the chart is fed forward at a constant speed of ¼in. per second.

The "Synclock" operated time switch—Fig. 4—is a time switch that requires no winding, regulating, or resetting, but if it is fitted with a solar correction dial, it acts as a street lighting time switch, which is absolutely automatic. It may be left entirely to itself from January to December, and will switch on and off within the desired number of minutes of sunset and sunrise each day throughout the year. These "Synclock" time switches are made in three patterns —(*a*) the street-lighting pattern, Fig. 4, which is supported and connected in circuit by a withdrawable three-pin and socket fitting; (*b*) a shop window switch, which is a compact and inexpensive switch for small installations; and (*c*) a heavy-duty time switch for water heating, large window lighting, and so forth. In this case the switch is contained in a cast iron case with a glass window, and with provision for sealing. Any of these time switches can be fitted with solar correction dials. In addition to these time switches, the firm has introduced a number of "Synclock" operated programme clocks, suitable for carrying out any desired programme of switching.

The instrument shown in Fig. 5 is the Everett Edgcumbe conduit tester, designed for measuring the resistance of a conduit. The I.E.E. wiring regulations stipulate that the resistance of the conduit in any installation as measured from the earthed end to the furthest point shall not exceed 2 ohms. Up to the present it has been customary to make the measurement with an ammeter, voltmeter, and accumulator or with a Wheatstone bridge galvanometer and battery. The conduit tester shown in Fig. 5, however, simplifies the task and should prove of considerable value to wiring contractors. The instrument comprises a direct reading indicator with a torch battery enclosed in a small wooden case, and long connecting leads terminating in bull-dog clips, as shown. It is only necessary to connect these leads to the two extremities of the conduit, press a button, and read off the resistance in ohms on the direct-reading scale, an adjustment being provided to compensate for any fall in the battery voltage.

The Record Electrical Company, Ltd., of Broadheath, Manchester, was exhibiting a range of its "Circscale" moving iron and moving coil indicating instruments, varying in size from 2½in. to 16in. in diameter. A set of electrical tachometers was also shown. These tachometer equipments consist of two units, a dynamo which generates a voltage proportional to the speed of the rotating body, and a voltmeter which measures the voltage and calibrated in revolutions per minute. The equipment is manufactured in three types—a lightweight type for aircraft, a general-purpose equipment, and a water-tight equipment for ships, the two last types being designed for running continuously for long periods without attention. The armature and field magnets of the dynamo are completely enclosed by a cast iron body, and in the case of the general-purpose outfit the case is dust and splash-proof; in the case of the water-tight unit, packing glands are provided round the shaft and in the terminal box. The output of the generator is sufficient to supply several moving coil indicators, which may be of the firm's "Circscale" or edgewise pattern. The former has a long scale, and is dead beat; and the latter is very compact and can be utilised with advantage when several speeds have to be compared, as the relative speeds can be distinguished by sighting the pointers along the dials. Among other instruments shown on the Record Electrical Company's stand was the "Circscale" workshop ohmmeter, illustrated in Fig. 6, which has three ranges, 0–100 ohms, 0–1000 ohms, and 0–10,000 ohms. The instrument is said to be quick in action and has a dead-beat movement, and readings can be taken directly off the 16in. scale. The instrument can be operated with dry cells or an accumulator, and with the addition of resistances from D.C. supply mains.

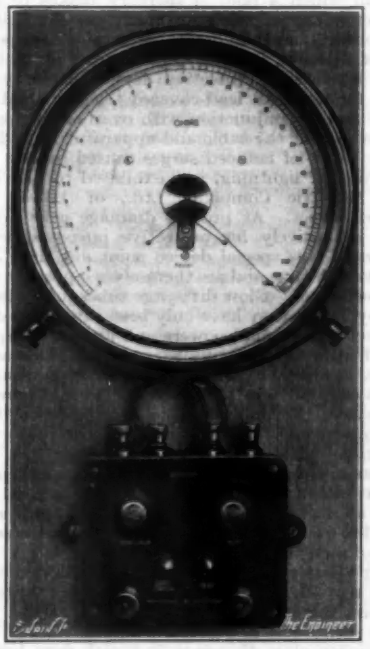


FIG. 6—WORKSHOP OHMMETER—RECORD

The Telegraph Construction and Maintenance Company, Ltd., of Wharf-road, City-road, N. 1., was exhibiting the high permeability alloys, radiometal and mumetal, and examples were shown of the different forms of strip, sheet wire, and rod composed of these alloys, together with made-up cores for transformers. Experimental demonstrations were given of the outstanding magnetic characteristics of mumetal. The diminution in the field strength around a coil by interposing a mumetal shield was shown by placing the mumetal shield between a search coil and the source of interference, when the hum in a loud-speaker associated with the search coil and an amplifier was reduced. Comparison between the reluctance of mumetal and soft iron was made by rotating samples carrying identical windings in a magnetic field, and the current generated in the two cases was compared by noting the deflection of a galvanometer. The permeability of transformer iron and mumetal was also compared by subjecting the samples to the same magnetising force, and by noting the deflection of a galvanometer, whilst the low hysteresis of mumetal was demonstrated by observing the angular deflection of a disc suspended in a rotating field. In accordance with this method of demonstration, which was devised by Mr. F. E. J. Ockenden, of Everett, Edgcumbe and Co., a comparison of the deflections of the disc gives the relative values of hysteresis for the two samples.

Typical examples of moving coil A.C. instruments, with a Westinghouse metal rectifier assembled in the case with a D.C. coil movement, were shown by the Westinghouse Brake and Saxby Signal Company, Ltd., of 82, York-road, King's Cross. The instruments exhibited included ammeters and milliammeters reading to 0·1 mA full scale and voltmeters reading down to 50 mV full scale. As the power consumption is very small—1 milliwatt at full scale for an average instrument, or 0·1 milliwatt for special laboratory types—it is possible to use these meters for making measurements which not long ago could only be made by means of thermionic valve voltmeters. Up to 2000 cycles the frequency error is said to be negligible, and it is only 2 per cent. or less at 5000 cycles, so that measurements can be made conveniently and with a fair degree of accuracy on L.F. amplifier and telephone apparatus. The modulation of wireless transmitters, &c., can also be easily checked. Recent investigations and improvements in the design of rectifier units for this purpose are said to have resulted in a considerable reduction of the temperature error, and in the majority of cases have enabled the instruments to comply with the B.E.S.A. sub-standard grade of accuracy. The scale is more open than that of any other type of A.C. voltmeter or ammeter, and in the case of some instruments the scale can be made absolutely linear. The instruments were loaned by Ernest Turner, Ltd., Everett, Edgcumbe, and Co., Ltd., and the Cambridge Instrument Company, all of whom manufacture instruments incorporating Westinghouse metal rectifiers. As explained in an article appearing in THE ENGINEER of September 4th, 1931, these rectifiers may be used with advantage for absorbing the energy of an inductive circuit, and rectifiers for this purpose were exhibited. The principle may be utilised in connection with any inductive circuit, such as the field circuits of automatically controlled rotary converters, magnetic chucks operating on D.C. mains, large solenoids or lift equipments, and the desired result may be obtained without the use of any special

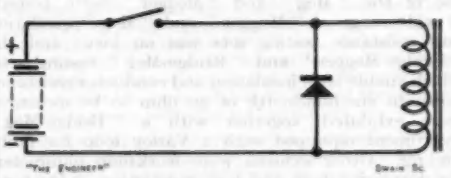


FIG. 7—INDUCTIVE CIRCUIT WITH RECTIFIER

switchgear, as indicated in Fig. 7, where the rectifier is shown connected directly across the inductance on the right.

Besides rheostats and resistances of various types, automatic voltage regulators and different types of photo-electric cells, Isenthal and Co., Ltd., of Ducon Works, Victoria-road, North Acton, were showing a selection of mercury switches and relays, which are

now widely used for various purposes in the electrical industry. The firm's new non-tilting mercury switch, known as the "Vertex" type, is of special interest and offers certain advantages, such as absence of noise and small dimensions. There are no moving leads and no wear on contacts. The apparatus consists of a solenoid which fits over the vertical mercury switch comprising a tube containing mercury and a quartz plunger with an iron shell. When the solenoid is energised the plunger is forced into the mercury which is displaced within the tube and is made to establish contact with an upper electrode. When the current flowing in the solenoid is interrupted the plunger rises, thereby lowering the mercury level and breaking contact. As all the parts that are exposed to the arc are made of quartz and the electrodes are of tungsten, there is practically no wear. The breaking capacity of the tube largely depends on whether the load is inductive or otherwise. The "Vertex" type of mercury switch is particularly suitable for operating in conjunction with contact thermometers and manometers, and Fig. 8 shows the method of utilising the switch in connection

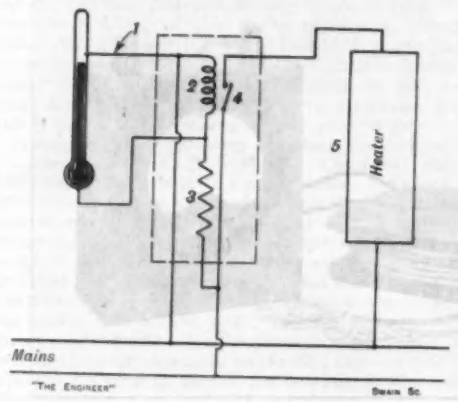


FIG. 8—MERCURY SWITCH—ISENTHAL

with temperature control, such, for example, as for ordinary living rooms, warm water apparatus, &c. As long as the temperature has not risen to the maximum value, the main current finds its way through the resistance 3, and the solenoid winding 2, and in consequence the mercury tube operates and closes contact 4 and the heater 5. As soon as the mercury in the thermometer reaches contact 1, however, the solenoid 2 is short circuited, with the result that contact 4 opens and disconnects the heater circuit 5. As the mains voltage is never impressed on the thermometer, its mercury remains clean and ensures perfect contact.

By means of a simple series of diagrams, the basic principles of various electrical instruments shown on the stand of Evershed and Vignoles, of Chiswick, were made clear to visitors. As is well known, a few years back the firm introduced the "Megger" earth tester for systematic routine earth tests. Since then a demand has arisen for a light and compact instrument which will enable the resistance of earth plates or towers to be tested without the aid of a water main or other assumed earth, and to meet that demand the "Meg" earth tester was introduced. The instrument gives a direct reading in ohms without calculation or adjustment, and is independent of electrolysis or vagabond currents. It is designed to give as wide a range as possible on a single scale, which is

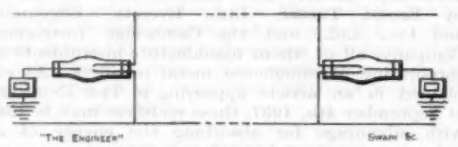


FIG. 9—SURGE PROTECTOR—EDISWAN

very open at the zero end and closes rapidly to the maximum readings. Over a considerable length of the scale readings of a fraction of an ohm are possible.

On the stand a model transmission line with towers was arranged for the purpose of demonstrating the use of the "Meg" and "Megger" earth testers. A wide range of "Megger" and "Meg" insulation and resistance testing sets was on view, and the "Bridge-Megger" and "Bridge-Meg" testing sets, which enable both insulation and conductor resistance down to one-hundredth of an ohm to be measured were exhibited, together with a "Bridge-Meg" instrument equipped with a Varley loop for fault-finding. Other exhibits were workshop ohmmeters for measuring high and low resistances, "Ductor" testing sets for testing low resistances of from 5 ohms down to 1 microhm, portable A.C. and D.C. instruments, portable and switchboard recording instruments, "Dionic" water testers, and the Evershed Midworth distant control system, described in our article on the Physical and Optical Societies' Exhibition held last year.

As regards the "Dionic" water tester, we scarcely need remind our readers that this is an industrial apparatus for measuring the electrical conductivity of water, thus enabling the amount of chemical impurity present to be determined by unskilled labour, both speedily and accurately. Its sensitivity is such that it can reveal traces of impurity which might otherwise escape detection by ordinary chemical methods. This instrument is made in two types, the portable "Dionic" water tester, especially designed for taking periodic tests, and the "Dionic" water purity meter, designed to enable a continuous check of the purity of the water to be kept. If it is desired to obtain a permanent record of the continuous test as it is made, a recorder may be used in conjunction with the latter type of instrument. Another pattern of this latter instrument, scaled in terms of grains of chlorine per gallon, is supplied as a salinometer for marine purposes.

Among the exhibits of Negretti and Zambra, Ltd., of 38, Holborn-viaduct, E.C., was a flow-operated cut-out, which gives warning when a flow of liquid ceases. The instrument—Fig. 10—is of value for safeguarding high-power wireless valves, air compressors, water-cooled engines, or any machine that depends for a certain flow of water for cooling purposes. In

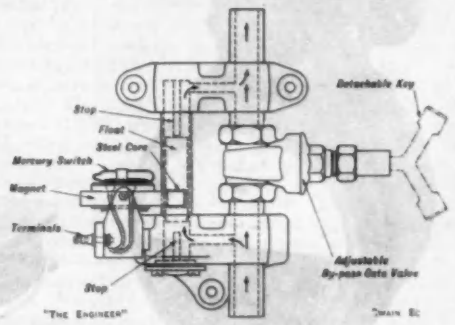


FIG. 10—LIQUID FLOW CUT-OUT—NEGRETTI

the event of the flow of water being cut down accidentally or ceasing altogether, warning is immediately given before serious damage is done to the plant. The cut-out is connected in series with the water supply, and the flow is slightly restricted through the instrument by an orifice consisting of an adjustable gate valve. The pressure difference on either side of the orifice causes a flow of water through a vertical tube in which a plunger or piston operates. The gate valve or orifice is adjusted by a removable key so that the minimum flow for safety causes the piston to ascend to the top of the vertical tube, whilst with a reduction in flow the piston falls to the bottom of the vertical tube. The movement of the piston is transmitted magnetically to a pivoted magnet surrounding the vertical tube, and on this magnet is fitted a mercury tube switch which makes or breaks the electric circuit as the magnet is tilted. The mercury tube switch consists of an hermetically-sealed glass tube in which a pool of mercury makes or brakes contact. The capacity is 2 ampères at 200 volts A.C. or D.C., and the device is suitable for operating starter switches, heating elements or alarum bells.

An interesting protective device primarily developed for use with lead-covered telephone cable run under and in conjunction with overhead power lines and to protect the cable and apparatus from damage as the result of induced surges caused by line faults, switching or lightning, was exhibited by the Edison Swan Electric Company, Ltd., of 123–5, Queen Victoria-street. At present drainage coils are used fairly extensively for protective purposes, but the makers of this special device point out they impose a load on the line and are themselves a possible source of interference. Glow discharge tubes have also been employed, but they have only been capable of dealing with relatively small powers and are said frequently to fail after the first discharge. The Ediswan protector, however, is claimed to be capable of clearing surges of from 10 to 15 ampères without detriment to the device. Normally no load is imposed on the line and immediately after the discharge normal working conditions obtain. In its simplest form the device consists of three or more tungsten electrodes enclosed in a tube containing an inert gas or a mixture of gases at a suitable pressure. One electrode is connected to each line, as shown in Fig. 9, and the remaining electrode or electrodes to earth.

Immediately the voltage of the telephone line rises above a pre-determined value a discharge takes place between the line electrodes and the earth. Small power surges of 1 or 2 ampères may be cleared by the preliminary glow discharge, but with very heavy or prolonged surges the glow discharge resolves itself into an arc, the cycle of operation being practically instantaneous. For telephone lines the striking potential has a peak value of approximately 200 volts, whilst the extinction potential is about 140 volts, although, if desired, these figures can be increased. The maximum value of the surge current is a function of the resistance of the telephone lines, and the makers have standardised certain sizes of electrodes in accordance with the general sizes of telephone wires. To meet special requirements, resistances, chokes, spark gaps, &c., may be used in conjunction with the protecting tube, but for general telephone protection no further accessories are required.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

PROFIT-SHARING.

SIR,—The economic problems which face the country to-day are of as much importance to engineers as to any section of the community, and I have no doubt that many of your readers, who, like myself, listened to Mr. Wickham Steed's broadcast address the other evening, were struck by the extraordinary common sense of his suggestions for the measures, which, if followed, he was convinced, would create almost a revolution in our manufacturing industries.

He claimed that the depressed state of so many of them is not due to lack of markets at home or abroad, but to the wrong relationships which exist between master and man, resulting in lack of interest of the latter in his work, involving perhaps poor quality, but certainly low production with attendant high costs.

His remedy, briefly, is the adoption to the widest possible extent of systems whereby every single employee shall have some share in the profits from the sale of the results of his labour, apart from the wages he gets for it.

Mr. Steed went on to cite several remarkable examples of businesses in which this plan has been followed with extraordinarily successful results.

One was a concern in New Zealand, two were in this country. In the case of the former, after an agreed upon percentage of profits has been paid to the shareholders, the balance—and there has always been one—is divided among the employees. The latter have also the right to elect a certain proportion of the board of directors. The results have been excellent all round. Costs were reduced, profits increased, there were no wages or other disputes, and an excellent team spirit prevailed throughout the whole organisation.

Of the two concerns in this country, one was in the Midlands and run on somewhat similar lines, and with equally satisfactory results. No overtime was necessary, because with a rush order every man put his back into his particular job, and all pulled together.

There was no standing off either, because the steady and honest work put in all round ensured maximum output with low production costs, resulting, in turn, in good quality and plenty of orders.

If these cases were not taken from actual life, one would feel inclined to treat them as glimpses of Utopia, but they simply show what can actually be done, if only the right relationships can be established between the employer and employee.

Mr. Wickham Steed is absolutely correct in maintaining that if all our industrial life could be modelled on the lines of the concerns he has instanced, we would be well on the way to the solution of all our economic problems.

One of the leaders in your current issue deals with the question of "brighter works." The plan followed in America of employing bright colours in manufacturing workshops is thoroughly sound psychology; make working conditions attractive, pay good wages, thus ensuring contented workpeople, and you will reap the benefit in output, low production costs and quality. Henry Ford does it, and his main business in life is not philanthropy.

Now, Sir, my object in writing—I fear at some considerable length—is to ask whether it is not possible for some definite action to be taken towards the examination of this profit-sharing idea, and its extension and application to our various industries, and particularly as applied to engineering.

Could you not take it up officially and urge it upon the Federation of British Industries or the Engineers Employers' Association or in some other way set it in train?

It is, of course, not a new idea, but has not been regarded seriously enough, many firms being too much inclined to look on it as an expensive fad, which only rich concerns like Cadbury's can afford.

Mr. Steed's examples, however, should be sufficient proof to the contrary.

Opposition would no doubt be forthcoming from trades union officials, but if the head of a works would only get a few of his foremen together and discuss the idea in an informal way to start with, I venture to say that the latter would give it their wholehearted support, and snap their fingers at the union leaders.

Trusting this is not a cry in the wilderness.

January 1st. F. N. B.

[Our correspondent is possibly not familiar with the extent to which profit-sharing has been tried in engineering and allied industries. It has been proved to be one of those economical measures which are admirable in theory but disappointing in practice. Generally speaking, Labour is more strongly opposed to it than Capital, and several promising schemes have been defeated by trades unionism. We may remind our correspondent that it is at least fifty years old in the engineering industry—Armstrongs adopted it in 1878—but despite its apparent advantages it has only succeeded in a few selected industries—gas companies for example. It is too large a subject to discuss here, but if our correspondent desires to pursue it he will find that it is covered in an extensive literature.—ED. THE E.]

HULL Corporation proposes to promote a Parliamentary Bill in the next session to enable it to take water from the Holderness agricultural drains and from the river Hull for industrial purposes.

Railway and Road Matters.

THE colour light signals that were being fixed by the Great Western on the four running lines between Paddington and Southall have now been completed and brought into use. They are 320 in number.

THE New Year Honours include a knighthood for Mr. James Milne, the general manager of the Great Western Railway, and one for Mr. A. A. L. Parsons, the Financial Commissioner on the Indian Railway Board. Mr. D. S. Burn, the agent of the Great Indian Peninsula Railway is given the C.I.E., and Mr. L. B. Bayley, of the Sudan Government Railways, is awarded the O.B.E.

THE correction herein on January 1st of the paragraph of December 25th as to the creosoting plant at Bo'ness should have said that the earlier paragraph omitted the word "Scottish." The new depôt at Bo'ness displaces an existing plant there and those at Ladybank and Granton, and the whole of the creosoting work for the L. and N.E.R. Southern Scottish area is now concentrated at Bo'ness.

IT is officially announced that the steamship service between Tilbury and Dunkirk, which was initiated in 1927, is to be transferred to Folkestone in May next. This decision of the Angleterre-Lorraine-Alsace Navigation Company must be very disappointing to the London, Midland and Scottish Company, as it has incurred a lot of expense over the new station at Tilbury, special train services, &c.

THE position of district engineer, Derby (North), L.M. and S. Railway, vacant by the retirement, on reaching age limit, of Mr. J. Brunton, has been filled by the appointment of Mr. R. T. McCallam, one of the New Works engineers. Mr. McCallam has been the resident engineer on the recently completed Broadholme and Ambergate and Barnt Green and Longbridge Widenings, both of which works included the opening out of tunnels built over eighty years ago.

THERE will be no Bill next session for any new railways. The only Bills promoted by railway companies are:—(1) That of the London, Midland and Scottish as to dock charges; and (2) one from the Southern for a new dock at Dover. It was stated when the notices of the latter were issued that provision had been made for the end-on loading of ships. A further notice, as to the capital required, shows that, as we anticipated at the time, that the end-on loading has reference to a proposed train ferry.

AT the annual meeting of the Pullman Car Company on December 21st it was stated that the company had been called upon by the Southern Railway to begin the delivery of the new cars required for the intense service on the Brighton and Worthing section, after the electrification is completed, in nine months' time. The efficiency and appearance of these cars would, the chairman thought, meet with public approval. The Southern had undertaken to find new services on which the displaced cars could be used.

WE mentioned herein, on December 4th, that, as a result of the refusal we reported on October 30th of the Interstate Commerce Commission to agree to the United States railways increasing their rates by 15 per cent., the companies approached the men with a view to accepting voluntarily a reduction in wages. The men refused to do so and thereby placed the railways in a quandary, since the only alternative was to take the case before the Railway Labour Board, the award of which would not be given for some months and might then be against the companies. The latest phase is that the representatives of the companies and of the men are to have a joint conference of nine members from each side to "negotiate to a conclusion."

THE incorporation, as from January 1st, in the Grand Union Canal Company of the Leicester Navigation, the Loughborough Navigation, and the Erewash Canal, prompts a reference to the fact that dissatisfaction of coalowners with the facilities offered by the latter two undertakings led to the formation of two railways that were later to be the basis of the Midland Railway. In response to an agitation, the Loughborough Navigation built the Charnwood Forest Canal so as to connect up the South Leicestershire coalfield. It was opened in 1798, but, in the following winter, burst its banks, and the damage was never repaired. The example set by the traders of Liverpool and Manchester in fighting the indifference and high charges of the Mersey and Irwell Navigation and the Bridgewater Canal led to powers being obtained in 1830 to build a railway from Swannington to Leicester. That, in turn, inspired the Notts. and Derbyshire coalowners to build the Midland Counties Railway from Derby and Nottingham to Rugby, where a junction was made with the London and Birmingham.

IT was seventy years on January 7th since John Ramsbottom's water trough and tender pick-up played a somewhat important part in national affairs. The British Government was anxiously awaiting a dispatch from Lord Lyons, the British Ambassador to the United States, as to what was known as the "Trent affair"—a blockade-running incident in the American Civil War in which this country was concerned. The Queen's Messenger arrived with the dispatch at Queenstown by the Cunard liner "Europa," and was conveyed by special train to Kingstown, where he crossed to Holyhead. The London and North-Western Company ran a special thence to Euston. The train consisted of three four-wheeled coaches, and was drawn to Stafford by engine "No. 229," of the "Lady of the Lake" class, and, after a pause of 1½ minutes, forward to Euston by "No. 372" of the "Bloomer" class. The 130½ miles to Stafford were covered in 2 hours 24 minutes, or a speed of 51·3 m.p.h., and the 133½ miles to Euston in 2 hours 19½ minutes, or 57·3 m.p.h. It was said at the time that the non-stop run from Holyhead to Stafford was made possible by the water trough at Aber, near Bangor, which had been laid in 1860. The reason why we mention this incident is that we noticed lately that in a paper read about a year ago by Mr. H. Chambers, of the Institution of Locomotive Engineers, that gentleman said that Ramsbottom invented the water trough in 1857. We suggest that that date should be 1860, as his patent is No. 1527 of that year.

Notes and Memoranda.

ONE of the locomotives of the London and North-Eastern Railway has maintained an average weekly distance of nearly 1200 miles for the past six years.

IN the course of a paper read before the Institute of Transport on mechanised marshalling yards on railways, Mr. H. H. Mauldin said that about six wagons per minute is about the maximum safe operating speed for European yards.

SEVERAL sewage outfalls have been installed on the Pacific Coast of America made of wood stave pipe. The pipe is joined up on the shore, floated out to sea and then sunk. It is said to adapt itself readily to inequalities of the bottom.

A PLANT for the spraying of timber with aluminium paint has been started in Toledo, Ohio, in which the control of the paint gun is effected by a photo-electric cell actuated by the passage of the timber through the painting chamber.

IN the course of a lecture before the Royal Society of Arts, Sir H. Maybury said that last year the total number of passengers conveyed by all public means of transport in London amounted to over 3,989,404,000. Of these, as many as 3,042,919,000 were carried by the omnibus and tramcar services.

SOME pertinent remarks on the relative merits of tar and bitumen for road-making purposes were made by Colonel E. B. Martin, the city engineer of Salford, on the occasion of a recent meeting of the British Road Tar Association. He was apparently in favour of the use of tar, but pointed out that although imported bitumen might cost £5 10s. a ton, of that amount as much as £4 2s. 8d. was expended in Britain.

AUSTENITIC steels of thin section can, according to the *Welder*, be satisfactorily welded by the roller type of seam-welding machine or be spot-welded, but very careful adjustment of current and pressure regulation is necessary. Unless these are given attention, pressure is applied to the material when passing through the 500 deg. to 900 deg. Cent. range and intercrystalline cracks occur. The weld junctions obtained are extremely sharp, and unless subsequently annealed the weld has every appearance of being brittle.

ACCORDING to Dr. O. G. Tietjens, who writes in the *Westinghouse International*, an electric locomotive travelling at 80 miles per hour requires five times as much power as when going at 40 miles per hour. In the case of a heavy locomotive and two heavy coaches, stream-line design saves 13 per cent. of the power at a speed of 35 miles an hour and 32 per cent. at a speed of 75 miles an hour. It requires 286 horse-power to drive an inter-urban street car at a speed of 80 miles an hour. Tests made in the Westinghouse wind tunnel indicate that the same type of car constructed with stream-line design can be driven at 80 miles an hour with only 140 horse-power.

THE narrow-gauge Dolomites Railway, which joins Calalzo, in the Piave Valley, to Dobbiaco, a distance of about 40 miles, receives its power from a three-phase network at Calalzo at a pressure of 18,000 volts; but for operating the railway direct current at 2700 volts is adopted. This is done by the use of only one sub-station situated near Cortina, a little more than half-way from the power terminus. The conversion of the alternating to direct current is done at the sub-station by means of two mercury arc rectifiers, each of 11,000 kilowatts capacity at 3000 volts. It is noteworthy that a momentary load of 200 per cent. does them no harm, and that they can withstand a 25 per cent. overload for half an hour.

IN a high-pressure boiler there is a system containing water, calcium sulphate, sodium carbonate, and sodium sulphate. While the sodium sulphate concentration is low, the sodium carbonate will react with the calcium sulphate to form calcium carbonate or chalk. This reaction, however, also produces sodium sulphate, which of necessity concentrates in the boiler water as evaporation takes place. When the concentration of the sodium sulphate reaches a certain value it tends to stop the reaction from carbonate to sulphate, and unless a considerable excess of the carbonate radical is present the reaction may be reversed, causing the formation of sulphate from carbonate, resulting in a calcium sulphate scale.

AT the Convention of Managers of Forestry Protective Associations recently held in Quebec, a demonstration was given of the operations of the new Marconi radio telephone for forestry protective work. Throughout the demonstration a special Marconi 15-watt transmitter was used, and a special 5-watt set was transported 15 miles distant. Communication was very distinct and clearly showed the possibilities of the wireless in this work. The complete equipment consists of a central station, capable of covering an area of between 75 and 100 miles, which serves as a main exchange. Circled about it are several stations of lower power that act as intermediaries, while in the area covered by the intermediaries listening posts are established. The rangers carry as part of their equipment a portable receiver, complete with batteries, earphones and protective case, weighing about 19 lb.

FROM time to time users of stationary batteries write to the *Chloride Chronicle* for advice concerning the specific gravity of the electrolyte, which, after, say, three or four years' service, has fallen perhaps 15 points, although the plates look healthy, the cells are worked lightly, are never overcharged, and no loss of acid can be credited, as in some cases the cells are of the sealed-in type. The lost acid is lying stratified at the bottom of the cell. (The effect can be reproduced by colouring some concentrated sulphuric acid and pouring it, without stirring, into a vessel containing weak acid.) At the commencement of charge strong acid can be seen oozing out of the plates like thin glycerine. Ordinarily, the gassing towards the end of a charge induces circulation of the electrolyte, sweeping up the strong acid and effecting thorough mixture of the strong with the weaker acid. Restoration to the original specific gravity can be secured by artificial circulation, such as by blowing through a tube.

Miscellanea.

THERE are now over 3000 men at work on the great Hoover Dam in the United States.

THE new ore-dressing laboratory of the Mining Department of the University of Birmingham has been officially opened.

A GOLD-BEARING reef 6ft. below the surface has been discovered during excavations on the site of a new post office in Von Brandis-square, in the centre of Johannesburg. The reef cannot, of course, be mined.

THE Exhibition commemorating the centenary of the demolition of old London Bridge, which was opened on November 5th in Regis House, close to the northern end of London Bridge, is to remain open until January 24th.

ARRANGEMENTS are being made for the production of Pierce-Arrow motor cars at Walkerville, Ontario. The eight-cylinder engine will deliver 125 horse-power, and the twelve-cylinder 150 horse-power, while wheel-bases will run from 137in. to 147in.

THERE are now some 300 British trawlers equipped with Marconi wireless installations, which enable them to secure news of the best fishing grounds and of the best markets for their fish. It is hoped that an extension of the programme will reduce the alternate gluts and scarcity which are common in the fishing industry.

IT is understood, says the *Daily Telegraph*, that the B.B.C. contemplates constructing in Broadcasting House a special television studio, to be equipped with Baird transmitting apparatus. This is a sequel to the announcement made recently by the B.B.C. that it had initiated discussions with Baird Television, Ltd., to explore the possibility of more active participation in the production of television transmissions.

THE Dominion Government has authorised the expenditure of 316,426 dollars for the improvement of Montreal Harbour. The work to be undertaken comprises the extension of the British American Oil Company's wharf of 228ft., and a new wharf of 107ft. for the Sun Oil Company, to be built of concrete crib. The work will be undertaken by the Harbour Commission, and is not likely to begin before the end of the winter.

IN order to encourage the use of electricity for commercial purposes, the Government of Mysore has sanctioned a reduced rate of 1 anna per unit for power supplied to business houses for purposes of advertisement during the night in their show-rooms. This concession will be in force for five years. For cooking and heating, the rate has already been reduced to ½ an anna per unit. (An anna is approximately equivalent to 1d.)

THE mirror for the new telescope at the Ohio Wesleyan University has been put in place. It is the third largest in existence, being 69in. in diameter, as compared with the 72in. of that at Victoria, British Columbia, and the 100in. of that at Mount Wilson, California. The Ohio mirror disc weighed 3000 lb. when cast, and required eight months to anneal. It has been tested to show that nowhere does it depart more than 0·01in. from its true focus of 25ft.

THE resignation is announced of Mr. van Sandick, the general secretary of the Royal Institution of Engineers of Holland, and chief editor of the technical weekly, the *Dutch Engineer*. Mr. van Sandick has been awarded the Gold Medal of the Institution of Engineers, and the Prince Consort presided at the reception given in his honour. Among the many letters received by Mr. van Sandick on his retirement were several from British engineering colleagues and friends, including one from the Institution of Electrical Engineers in London.

THE Dominion Government has appointed a Royal Commission to inquire into the whole problem of transportation in Canada, particularly in relation to railways, shipping and communication facilities. The Commission consists of The Right Hon. Lord Ashfield, The Right Hon. Lyman Poore Duff, P.C., of Ottawa, Ontario; Sir Joseph Flavelle, of Toronto; Mr. Beaudry Leman, of Montreal; Mr. Leonor Fresnal Loree, of New York; Mr. Walter Charles Murray, of Saskatoon, and Mr. John Clarence Webster, of Shediac, N.B.

THE Lake Shore Mines at Kirkland Lake, Ontario, are putting in a new electric winder built by the Canadian Westinghouse Company. It is of 1350 horse-power, and will give a pull of 45,000 lb. at a speed of 2000ft. per minute. The drums are 10ft. in diameter and each weighs 32½ tons. For the first time in Canada, and probably on the North American Continent, it is stated, spherical roller bearings are being used in mine hoist construction, these being the product of the Canadian S K F Company, of Toronto. The winder will raise ore from a depth of 4200ft.

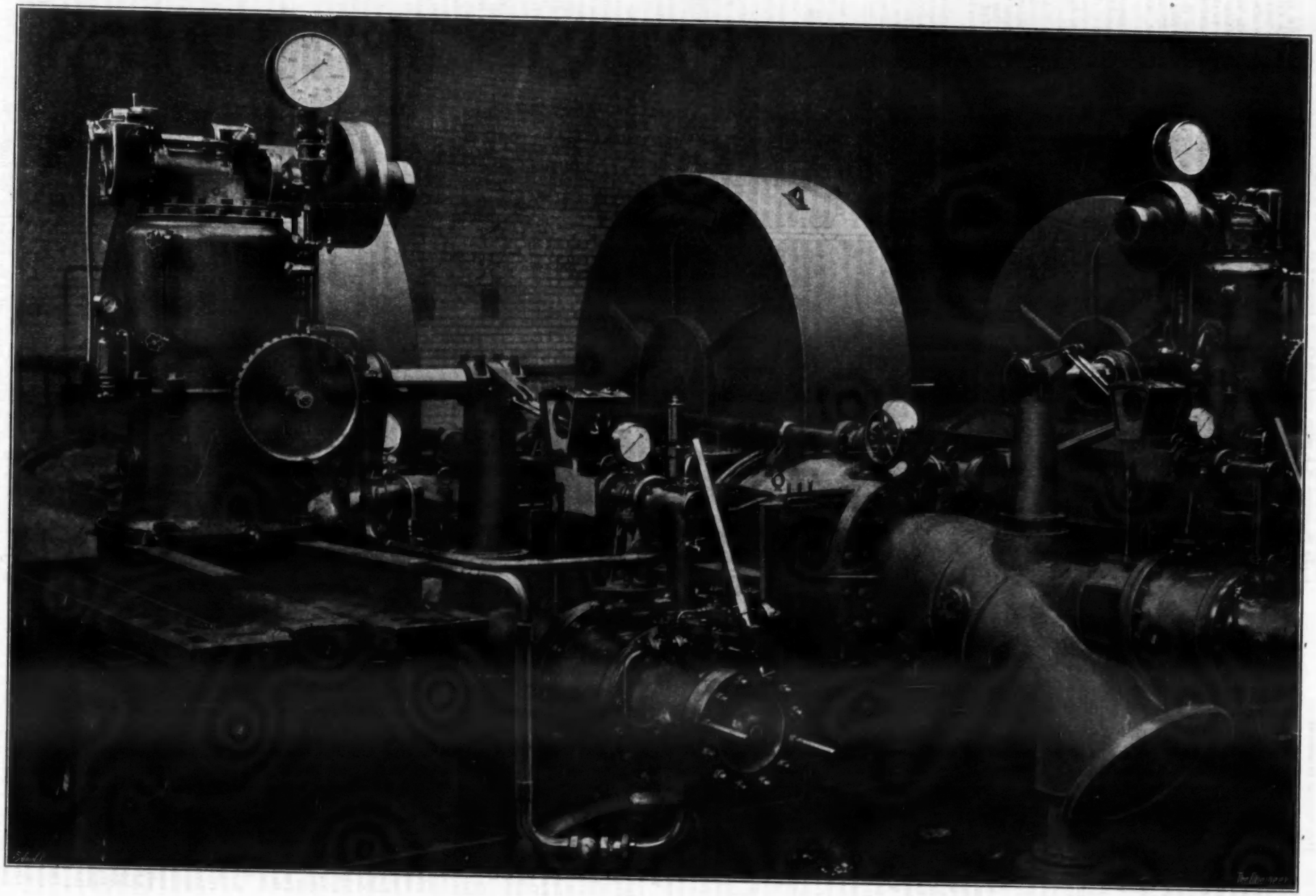
TRADE figures between China and Canada during 1930, as revealed in the Customs returns, show that imports into China from Canada fell from Hk. Tls. 38,476,967 in 1929 to Hk. Tls. 13,517,476—a shrinkage of Hk. Tls. 24,959,461, or roughly 75 per cent.; while exports to Canada rose from Hk. Tls. 2,160,299 in 1929 to Hk. Tls. 3,490,624 in 1930, representing an increase of Hk. Tls. 1,330,325, or approximately 60 per cent. In both instances the difference between the figures for the two years is more marked than in the case of any other country with which China has trade relations. Most of the increase in exports is accounted for by ground nut oil.

THE total value of metals produced in the United States in 1930 decreased about 33 per cent. from 1929. Most striking were the notable declines in value of the major metals, ranging from 30 to 49 per cent. for copper, pig iron, lead, silver, and zinc. The decreases for some of the other metals, such as mercury, were somewhat more moderate. Only gold, the standard price of which was not affected by the business depression, showed an increase in value that accompanied a gain of 3·5 per cent. in output. Aluminium, manganese ore, and cadmium made moderate gains in production, but the total values were slightly less than in the preceding year. All producers of metals felt sharply the effect of weakened prices and generally reduced output.

17,000 HORSE POWER PELTON WHEELS FOR THE PUNJAB

BOVING AND CO., LTD., LONDON, ENGINEERS

(*For description see page 49*)



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NOTICES TO READERS.

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THE STABILISATION OF SHIPS.

THERE are still many people, more particularly in this country, who regard any attempt to modify by mechanical means the rolling of ships among waves as something savouring of an unwarranted interference with Nature which man may essay only at his peril. That attitude towards the subject is as illogical as it is widespread. A ship is a man-made structure, and not a natural body. She rolls among waves not because rolling is natural, but because, like other products of the human mind and hand, she is imperfect. By suitable design of the hull form and by the fitting of bilge keels, much can be done that will affect the rolling characteristics of a ship. Such steps are not regarded as unnatural. They are accepted as legitimate, and the naval architect might well be held blameworthy if he neglected to employ them to their fullest extent for the purpose of reducing rolling. It is no more unnatural to take steps towards carrying the reduction of rolling a stage or several stages further, even to the extent of aiming at its complete suppression. Apart from those who argue in such manner, there are still many people who believe that the automatic stabilisation of ships against rolling has yet to emerge as a practical reality from the visionary dreams of enthusiastic inventors. The actual facts are that one system of reducing rolling, namely, the anti-rolling tank system associated with Herr Frahm's name, is now in use on well over a million tons of merchant shipping, and during the war was fitted in seventy-two submarines and in several destroyers and small cruisers. The other practicable system—the gyroscopic system, as developed by the late Dr. E. A. Sperry—has been fitted in a large number of pleasure yachts, ranging in displacement up to 5600 tons and in a 10,000-ton aircraft carrier, and is now being installed in a destroyer and in a 45,000-ton Transatlantic liner. These facts are hardly consistent with the belief that the automatic stabilisation of ships is still in the purely experimental stage.

The description of the gyroscopic stabilising equipment for the Lloyd Sabaudo liner "Conte di Savoia," of which the first part appears elsewhere in this issue, will, we believe, be read with interest by naval architects and other technical people and by shipowners. That equipment possesses a considerable measure of international appeal. The system upon which it operates was invented and developed in the United States of America. The actual equipment, both mechanical and electrical, was made wholly, or almost wholly, in Great Britain by British engineers. The ship on which it is being fitted is Italian built and owned. In its general principle of action the equipment is identical with other examples representing the established practice of the late Dr. Sperry, but in its details and in its arrangement on the ship it has many novel features. It consists of three separate and independent units, each having a fly-wheel 13ft. in diameter weighing 110 tons and spinning at from 800 to 910 revolutions per minute. The three units are to be placed close together in a compartment forward of the bridge and at or below the level of the external water surface. The number of units in action at any one time and the speed of spinning of the fly-wheels of those which are at work will be varied to suit the prevailing weather conditions. Each fly-wheel is driven by a spinning motor of 560 horse-power and, in addition, each unit has a precession motor of 100 horse-power. The total motive power provided for the equipment is therefore just short of 2000 horse-power, excluding the power expended on circulating the lubricating oil and on other minor services. The total weight of the equipment exceeds 600 tons, or about 1¼ per cent. of the vessel's displacement. We understand that two engineers per watch will be detailed to look after it. It is anticipated that in general the equipment will be capable of maintaining the vessel on an even keel to within 2 deg. or 3 deg. of roll. Shipowners and naval architects will naturally not be content with the detailed technical information which we place before them in our articles, full as that information may be. They will desire to know the capital cost of the equipment, to have figures relating to its upkeep, and to have precise data concerning its performance at sea. What gain, they will ask, can we expect by adopting stabilisers on our own ships? Admittedly the "Conte di Savoia" will be a liner of the "luxury" class, but comfort of the passengers is not the only consideration which should be taken into account. On the technical side there are various assets or possible assets. One possibility worthy of serious study is the extent to which economising modifications may be made in the design of the hull by virtue of the fact that its stability in rough weather is guaranteed by the automatic equipment. For example, it might be deemed unnecessary to fit an automatically stabilised vessel with bilge keels. As a direct consequence the hull resistance would be reduced and power would be economised, conceivably to an extent sufficient to compensate for the power expended in operating the stabilising equipment. There are other possibilities of a similar kind which no doubt will be obvious to naval architects. Again, it is certain, in spite of a widely held belief to the contrary, that in many respects the hull of a stabilised ship is subjected to less severe stresses by the waves than is the hull of a non-stabilised ship. Notably in this connection there is an absence of the racking stresses which are produced by rolling and which have been a frequent cause of fracture of brackets, pipes and other parts of the non-stabilised ship's structure or fittings. In addition, some gain may undoubtedly be expected in a ship's speed during rough weather if she is automatically stabilised.

From the purely technical point of view, automatic stabilisation for ships, whether by anti-rolling tanks or by gyroscopes, has, it is safe to say, now passed well beyond the experimental stage. There was nothing that was experimental, we can assure our readers, about the equipment which we saw a month ago under test at Vickers-Armstrongs' Barrow works. It was impressive not only because of its capacity and intended function, but also because it manifested unmistakably its designers' and constructors' confidence in themselves and in the principle to which they were giving effect. It may be regarded as a very bold course to proceed at one step from the stabilisation of a 10,000-ton aircraft carrier to a 45,000-ton Transatlantic liner. The principle is, however, the same, whether the vessel is large or small. To pass from a small to a large scale is well within the productive ability of modern engineering resources. On the commercial side, we prefer to say little, because we recognise that the whole of the data requisite for passing a sound opinion is not at our command, or is not yet fully available. A critic has said that it is not our business to discuss the commercial side of the subject, and that we ought to confine ourselves to its purely technical aspects. We cannot, however, be indifferent to the fact that British shipowners and shipbuilders have hitherto manifested a prejudice against all forms of stabilising devices. It has been stated once or twice in the daily Press that the new Cunard liner was to have been fitted with gyroscopic stabilisers. One such statement was traced to its source, and was found to have originated in a confusion of the new Cunarder with the "Conte di Savoia." So far as we can discover, the only British vessel, built or being built, which is fitted with any system of automatic stabilisation is the "Aquitania," and in that case the Frahm tanks are being used as additional fuel bunkers, and not for their original purpose. Meanwhile, nearly all the large German liners—including the "Bremen" and "Europa," which, it has been asserted, are now attracting the cream of the Atlantic traffic—are fitted with Frahm tanks, and the Italians are about to place in service yet another competitor fitted with gyroscopic stabilisers. It seems desirable that British shipowners, in these lean times, should at least review their attitude towards automatic stabilisation, and that its commercial aspects should be studied as closely as have been its technical aspects.

Skill as a National Asset.

IN an industrial period, now unhappily becoming remote, England took a particular pride in the skill of her craftsmen. In all the mechanical arts, from wooden shipbuilding to clockmaking, they had no superiors and few equals. Their reputation spread through the world, and by extending the foreign trade of this country gave them ever more and more opportunities for the development of their dexterity. But the very thing that was making the great craftsman was also destroying him. As his products multiplied the demand for them increased until it could no longer be satisfied by manual skill alone, and the skilled machine began to take the place of the skilled mechanic. Maudslay invented the engineers' slide-rest, Roberts the planing machine, Nasmyth the milling machine, whilst others, with Brunel's famous block-making plant as their exemplar, busied themselves with woodworking tools or laid the foundation of mass production methods. The example set by this race of mechanical engineers was pursued elsewhere and eventually, owing to her own industrial conditions, was carried further in America than in Europe. The nineteenth century saw the rise of tools which augmented the productivity of the skilful hand and alert mind; but it saw, also, before its close the supersession of those tools by others which were almost magical in their performance, far more rapid than the swiftest workman, and which, owing to their automaticity, could make the veriest tyro equal in a few weeks the artisan who had learnt his "mystery" by long apprenticeship. Were not belief made *blasé* by experience, the ability of fully automatic machines would be incredible; they seem almost to combine human intelligence with mechanical dexterity. Already such things as motor car frames are fabricated in "automatic workshops," and it is only because it is at present uneconomical so to do that complete machines of a complex nature are not made and assembled in all their parts by machinery directed by a mere handful of operatives.

So quickly has this change come upon us that we have not yet oriented ourselves to the new conditions. In Europe particularly, where the traditions of centuries are firmly fixed, faith in skill is not easily deposed. Here we cannot bring ourselves to acceptance of the hard fact that manual dexterity is of greater industrial and economic value than high craftsmanship. It still seems to us unjust that the man without training should actually be able to earn as much as, and even more, than he who has served apprenticeship to a craft. We cannot lift ourselves out of the atmosphere of the past. We find it hard to acknowledge the fact that is thrust upon our notice every moment of the day that it is not skill, but output, that we need. If the machine can do the work as accurately as the hand and a thousand times as fast, then we must laud the machine and reward the hand that tends it. We no longer want skill for skill's sake; we no longer want it because only through it is perfection possible; we no longer want it because it gives a personality to the thing produced. Whilst commodities were made by the units and dozens, like Chippendale chairs or Smith's chronometers, then might we praise the skill of the craftsmen, but when chairs of steel tubes are turned out by the thousand and cheap watches by the million, we are more concerned that the price should be low and the output high, than how or by whom they were made. In the New World there has been little

opposition to the triumph of the unskilled. As lightly as the typist has displaced the caligrapher, the machine operator has routed the mechanic. What in the first place was dictated by the scarcity of trained men has become the established practice, and the nation takes in its mechanisation of production the same pride that we once took, and which still lingers, in the high skill of our craftsmen.

The new conditions have brought with them new problems, which so far, in the Old World at least, have been only partially solved. It is manifest that apprenticeship to a trade is no longer a necessity. Anyone may learn in a few weeks the simple craft that is sufficient for the earning of a livelihood. If apprenticeship is retained it is because it has the characteristics of a qualifying examination and, under trades union rules, regulates the inflow of labour. Or, looked at in a larger way, because the training is a desirable form of discipline; and, finally, because there remain a few workshop crafts in which the need of skill has not yet been displaced by the perfectioning of mechanisms. It was on the latter that Major F. L. Watson, Chairman of the Yorkshire Branch of the Institution of Mechanical Engineers, laid stress in a thoughtful address which he delivered a few weeks ago. "Standardised production, or repetition work," he said, "is the highway to cost reduction, and it involves machine finish, replacing hand finish, and the elimination of skilled labour in actual production. But it involves also even higher skill than formerly in machine construction and maintenance, and in gauge, jig, and tool making. The difficulty of reward arises at once. The machine minder has the opportunity of making much more than his nominal wage by piecework or bonus. The skilled man who keeps the machine going, and whose gauge and jig work secures the quality of the product, gets left behind. Of the total product the unskilled gets more than his due proportion, the skilled man gets less." There, in outline, is one of the problems to which we have referred. If men may readily make a livelihood without being skilled, what inducement can we hold out to them to become skilled? The answer is far from easy to find, but it is essential that it should exist until such time as even the present proportion of skill is displaced by the relentless advance of mechanism.

Water Supply in 1931.

No. I.

General Survey.

Two leading occurrences of the year were the practical completion by Bradford of the Scar House Reservoir works, which have been in progress for a number of years past, and the decision of Manchester to suspend temporarily the major portion of the operations on the Haweswater scheme. Further references are made to these undertakings in separate paragraphs below. The progress made with the waterworks in a number of other places is also given in separate paragraphs, which, however, by no means sum up the whole of the work that was done during the year; several schemes were brought to a termination, numbers were further advanced and a great many others were initiated. Shrewsbury, for example, adopted a proposal for supplying the town and district with water from the River Severn, the estimated cost being upwards of £116,000. On the other hand, the Hartlepool Gas and Water Company decided, in consequence of the prevailing trade depression, to postpone the construction of a reservoir, which was to have cost £60,000. Another undertaking to be abandoned, for the time being at any rate, was a regional scheme for the county of Banff, which would have necessitated the laying of a pipe line 50 miles long, and would have involved the expenditure of some £300,000. Hexham opened new works which included the laying of some 10 miles of pipe line. Tunbridge Wells completed and put into operation a new pumping station. Hull increased its supply to the extent of 10 million gallons per day by the putting in service of a new works at Dunswell, near Beverley. The pumping plant consists of two sets of three-throw deep well pumps, each designed to lift 5 million gallons of water per day, and each driven by a marine-type Brotherhood-Still two-cylinder oil-steam engine of 420 B.H.P. We believe that this is the first occasion on which such a combination has been employed for waterworks purposes. The County of Ayr has in hand a scheme which is estimated to cost over £342,000. In the early part of the year a scheme to take water to Kingsbridge, Totness, and other districts, at a cost of some £50,000, was approved. The Holland Regional Water Committee had under consideration a scheme for pooling the water resources of the county. The proposal included the laying of 190 miles of distributing pipes and the estimated cost is put at £350,000. Halifax installed new filtration plant at a cost of upwards of £80,000. Leicester was engaged in the laying of a second pipe line between Sawley and Hallgates to bring an additional supply of water from the Derwent Valley works. Rhosneigr put into operation new supply works. The water is obtained from a lake from which it is abstracted by an intake tunnel driven from a well on the bank, partly through rock and partly through gravel. Reagents in the form of sulphate of alumina and calcium hydrate are added prior to filtration.

In addition to the foregoing, the following places and bodies either applied or decided to apply for sanction to borrow varying amounts for waterworks purposes:—Brigg (£40,000), Congleton (£87,500), Leeds (£25,830), Mablethorpe (£26,540), Nantwich (£128,600), North Kesteven (£60,000), Nottingham (£149,000), Penrith (£28,500), Petersfield (£54,750), Runcorn (£25,000), Swindon (£151,000), Wellington (£35,300), Wincanton (£38,000), and Wycombe (£119,000).

Reservoirs (Safety Provisions) Act, 1930.

The opening event of the year was the coming into force on January 1st of the Reservoirs (Safety Provisions) Act of 1930. By that Act it is provided, amongst other things, that a large reservoir shall not be constructed unless "a qualified civil engineer" is employed to design and supervise its construction. A "large reservoir" is described as being a reservoir designed to hold, or capable of holding, more than 5 million gallons of water above the natural level of any part of the land adjoining the reservoir. A "qualified civil engineer" is described as meaning a civil engineer who "is a member of the panel of Civil Engineers constituted for the purposes of this Act, or, if different panels are constituted for different purposes of this Act, or for different Classes of reservoirs, a member of the appropriate panel." The Act also provides that these engineers are to be appointed by the Secretary of State, in conjunction with the Ministry of Health, and the Department of Health for Scotland.

London.

Particulars regarding the principal works that were carried out during the year by the Engineering Department of the Metropolitan Water Board, which have been kindly supplied to us by Mr. Henry E. Stilgoe, M. Inst. C.E., will be found on page 47 of this issue, being too long for inclusion in the present article.

Barnoldswick.

The Barnoldswick Urban District Council, not long before the close of the year, completed an impounding reservoir at Elslack. The reservoir, which will, when full, contain 100 million gallons, with a top water level of 690ft. above O.D., is formed partly by an earth embankment across the valley of the Elslack Beck and partly by excavation. The embankment is 1480ft. long and has a maximum height of 84ft., while the maximum depth of water will be 50ft. The reservoir has a water area of 13·8 acres, and has a concrete lining with an asphalt surface. A temporary overflow has been provided to restrict the depth at present to 35ft., and the capacity to 50 million gallons to enable the earth embankment to consolidate before the concrete lining is finished. There is a complete system of by-pass channels so that the reservoir can be emptied whilst still maintaining the water supply to the town. The cost of the works is estimated at a little over £150,000.

Belfast.

Considerable progress was made in the construction of the Silent Valley Reservoir, the puddle core wall and embankment being within 10ft. of the full height, and by the end of the year water was impounded in the reservoir to a depth of 26ft. At the present rate of progress it is anticipated that the whole of the work will be completed by the summer of 1932. The contract is being carried out by Sir Ernest William Moir and Co., Ltd., under the direction of a board of engineers, consisting of Mr. W. J. E. Binnie, Mr. H. P. Hill, and Mr. E. Sandeman, with Mr. G. McIldowie as resident engineer.

Birmingham.

Elan Aqueduct.—The extension of the third main in 60in. steel pipes was steadily continued throughout the past year by three administration gangs. A length of two-thirds of a mile was completed and brought into commission on the Clywedog Siphon. Similar work of greater length was in progress on the Downton, Teme and Severn Siphons, which, it is expected, will be completed during this year. The present capacity of the Elan Aqueduct is estimated at 31 million gallons a day, and consequent on the existing demand for water the whole of the distribution area is now supplied with Welsh Water.

Bartley Reservoir.—The first filling of the Bartley Reservoir for testing purposes which was in progress at the end of the year 1930 was continued during 1931 with water from the Elan Aqueduct, and was completed on April 2nd, the total capacity of the Reservoir being 541 million gallons. With only slight variations in water level, the Reservoir remained full throughout the past nine months, but the necessity for taking it into commission did not arise during the year. Work was in progress at the embankment on the screen wall, footpaths and roadway, and that work still continues.

Area of Supply.—A new 24in. trunk main in steel pipes is being laid on the Northfield level from Frankley Pumping Station to the Harborne District, where considerable building development is taking place. Some 5 miles of 15in. and 12in. cast iron pipe were laid during the year to improve the supply in the higher portions of the Handsworth, Perry Barr and Shirley areas, which are supplied from the Warley and Northfield Reservoirs.

New Central Depôt.—The work on the central depôt for stores, workshops and testing at Edgbaston made considerable progress during the year. It is anticipated that a move will be made from Brasshouse-passage in Broad-street during the coming spring.

Bradford.

The completion of the Scar House dam and reservoir works was brought appreciably nearer during the year. We have referred to these important works on several occasions in the past, so that it will only be necessary in the present instance to say that, included in the progress made during the year, was the building of ten masonry arches, each of 30ft. span and 10ft. rise, over the spillway, to carry the road which is being constructed across the dam. The surface of the roadway is about 14ft. above top water level, and the superstructure of the dam is designed to allow for a length of 530 yards of road formation, 11ft. 4in. wide between parapets. The work of carrying those portions of the dam to the north and south of the spillway to roadway level continues. The tunnel, which is to convey the waters of the Howstean catchment area to the reservoir, was nearing completion at the end of the year. It is 1852 yards in length, and is carried chiefly through shale and sandstone. The sides and roof were lined with concrete as the heading progressed and the final penetration was satisfactorily effected in August. Since that date, rapid progress has been made with the concreting of the invert.

Chatham.

A new pumping station and service reservoir was completed by the Chatham Water Company. A well was sunk in the chalk in the Nashenden Valley, and headings are being driven at the present time, and it is confidently expected that an ample supply of water will be found. The pumping machinery consists of centrifugal bore-hole pumps, driven by Diesel engines through gearing, and the plant, which has been manufactured by Worthington-Simpson, Ltd., is designed to lift water at the rate of about 1¼ million gallons per day to a service reservoir constructed with mass concrete walls and reinforced concrete floor, columns, and roof, and having a capacity of 2 million gallons.

Coventry.

The Meriden covered service reservoir for the Coventry waterworks extension, which will have a capacity of 10 million gallons of water, was formally opened on September 17th, and is now being filled for testing. The Arnold Farm reinforced concrete water tower, which has a capacity of 300,000 gallons, and stands at a height of 70ft. above ground, was completed and tested, with satisfactory results. The walls and a portion of the concrete floor of the Coundon covered service reservoir were completed. This reservoir will have a capacity of 9 million gallons, and will augment the storage of the low-level zone of supply. The old steam pumps at the Whitley pumping station were removed and replaced by duplicate electrically-driven bore-hole centrifugal pumps supplied and erected by the Harland Engineering Company, Ltd. These works are being carried out by contract under Sir Alex. Binnie, Son and Deacon as engineers, the resident engineer at Coventry being Mr. J. S. Jackson.

Durham County.

The construction of the Burnhope Reservoir by the Durham County Water Board was authorised by Parliament in the Board's Act of 1922. The site of the reservoir embankment is near Wearhead, about ¼ mile from the railway station of that name, and geologically on the carboniferous rocks. The work was begun on January 6th, 1930, and has since been continued without interruption. In August last the tunnel driven through the solid ground at the south-eastern end of the intended earthen embankment was sufficiently completed to enable the river to be diverted through it, and to convey, past the works, floods which may from time to time occur. The embankment will have a maximum height of 130ft. Its total length will be about 600 yards, and it will contain 1¾ million yards of material. It will intercept waters derived from a drainage area of 4480 acres, and will also store waters collected by catchwaters from areas aggregating 6090 acres. The catchwaters were practically finished during the year, work on them having been expedited with the object of affording immediate employment to as many men as practicable, and thereby to fulfil a condition stipulated for by the Development Grants Committee, through which

Department certain financial relief was afforded. Considerable progress was made with the main cut-off trench, valve shaft and other principal works, in addition to which a number of lodging huts and buildings have been erected for the accommodation of workmen and are in occupation. An access road has been formed up the valley for the direct delivery of materials at the site. It is estimated that the total cost of the work will amount to £982,000. Construction is being performed by direct labour, from 400 to 1000 men being daily engaged. The design and supervision of the work was entrusted to the joint engineers, Messrs. Walter S. Nicholson and W. J. E. Binnie, of the firms of T. and C. Hawksley and Sir Alexander Binnie, Son and Deacon respectively, the resident engineer being Mr. S. S. Alderidge.

Lancaster.

A start was made with the construction of the Langthwaite Reservoir for the Lancaster Corporation, under powers obtained by the Act of 1918. The reservoir will have a capacity of about 170,000,000 gallons. A Government grant was obtained, and the work is being carried out by direct labour.

Liverpool.

Vyrnwy Aqueduct.—During the past six years the carrying capacity of the Vyrnwy aqueduct has been gradually increased by laying lengths of the third pipe line on the various sections, which lengths are coupled by cross connections to the existing two mains. During 1931 work of this character was continued on the Hirnant-Morda section which conveys unfiltered water from Lake Vyrnwy to the filter beds at Oswestry. The length is divided into two portions—one on each side of the balancing reservoirs at Parc Uchaf. The upper portion continues the third main, already laid, for a distance of 3·3 miles to the River Rhaiadr, whilst the lower length starts at Parc Uchaf reservoirs and joins up to that portion of the third main which was laid in 1926. The total length of the main now being laid is 5·2 miles. The work presents several difficult features, as the River Tanat and the Great Western Railway have to be crossed, whilst two very steep dingles are also traversed. The pipes are of steel, 42in. internal diameter, $\frac{7}{16}$in. thick, and are protected internally by a lining of bitumen $\frac{3}{8}$in. thick applied centrifugally, as were the pipes in the third section already laid. An important improvement has, however, been made in connection with the external protection of the pipes. On the lengths previously laid, the pipes had been covered with a double-spiral wrapping of hessian cloth impregnated with hot bitumen. In the present case, that form of protection is replaced by rolling a $\frac{1}{4}$in. thickness of hot bituminous mixture on to the outside of the pipe without hessian, and after the pipes have been jointed the sockets are covered by pure bitumen run hot into aluminium moulds which clip around the pipe. Owing to the hilly nature of the country and the narrowness of some of the roads along which the pipes have to be transported, the length of the ordinary pipes was restricted to 25ft. instead of the 30ft. length which had been successfully used on the Cotebrook–Norton Section. Since February, when the delivery of pipes began, 90 per cent. of the whole length had been laid up to the end of the year. The pipes were made by Cochrane and Co., Ltd., and laid by Sir William Prescott and Sons, Ltd., the valves being supplied by Blakeborough and Sons, and Guest and Chrimes, Ltd.

Aber Tunnel.—Work at the new Aber Tunnel was confined to the building of the brick lining at those points where the rock was not sufficiently sound to stand without support. The lining at the inlet end was practically completed, whilst that at the outlet end will be finished in a few months.

Aubrey-street High Level Station.—An important development in connection with the distribution system in Liverpool was carried out during the year by the installation at the Aubrey-street high level station of an automatically operated electrical pumping plant. It replaces a Cornish pumping engine, and consists of three separate, electrically-driven, centrifugal pumps, each capable of delivering 2500 gallons per minute against a head of 110ft., or 2750 gallons against 105ft. The pumps, which are coupled direct to 400-volt squirrel-cage induction motors, each of 125 B.H.P., run at 1470 revolutions per minute. As the pumps are fixed at such a level that they work with a suction lift which may be as much as 21ft., air ejectors have been fitted to the top of the pump casing of each unit. The pumps are controlled by relay switches fixed at the high-level tank to which water is delivered, whilst the operation of the sets is controlled by an automatic switchboard which is provided with safeguards against every likely cause of failure. The pumps, motors, air ejectors, &c., were supplied and erected by Mather and Platt, Ltd., and the automatic low-tension control gear by Metropolitan-Vickers, Ltd.

Llanelly.

The new source of water supply for Llanelly from the Gwendraeth Valley was formally put into service on October 15th. The undertaking, an illustrated description of which was given in our issue of October 16th, comprises an intake on the Gwendraeth Fach River, by means of a weir thrown across the stream at a point 1½ miles upstream from the borough of Kidwelly. The diverted water is led into a sedimentation reservoir of nearly half a million gallon capacity, having rough screens at the inlet and outlet. Adjoining the intake are stilling chambers furnished with a V notch for measuring the compensation water, which must be at least 500,000 gallons per day. From the sedimentation tank, the water flows by gravity through pipes of varying diameter to a covered balancing and regulating reservoir and pumping station at Pembrey, a distance of 5½ miles, the water as it enters the reservoir passing through two sets of fine gauge wire mesh screens, the first having 100 holes and the second 400 holes per square inch of surface. The pumping plant consists of three sets of three-stage "Plurovane" turbine pumps driven by Blackstone twin-cylinder crude-oil engines each capable of a continuous duty of 111 B.H.P. The maximum head against which the plant is designed to operate is 375ft. The water is raised into either one or the other of two previously existing reservoirs within the Lliedi watershed, through a cast iron pipe line, 20in. in diameter and 8½ miles in length, the combined capacity of the pumping plant being 3 million gallons per day.

(To be continued.)

Metropolitan Water Board.

THE following particulars regarding the principal works which were carried out during the year 1931 by the Engineering Department of the Metropolitan Water Board, and concerning the proposals for the forthcoming twelve months, have been courteously supplied to us by the Chief Engineer, Mr. Henry E. Stilgoe, C.B.E., M. Inst. C.E.

WORKS IN CONNECTION WITH THE SUPPLY FROM QUEEN MARY RESERVOIR AT LITTLETON.

Pumping Plant, Kempton Park.—A high-speed steam engine driving a centrifugal pump, was installed in the old engine-house at Kempton for raising 16 million gallons per day of raw water into the Kempton Park reservoirs or on to the primary filters. It is intended to assist and act as a standby to the existing low-lift reciprocating pumps. The Board accepted the tender of Worthington Simpson, Ltd., for the supply of two steam turbine-driven centrifugal pumps, each set capable of pumping 24 million gallons per day against a head of 200ft., or 12 million gallons per day against a head of 400ft. These units will be installed in the new engine-house to assist and act as standbys to the existing high-lift pumps.

Haggar-lane Pumping Station, Woodford.—The remodelling of this station is in progress. The old boiler-house was demolished and replaced by a new engine-house, in which have been installed two sets of oil-engine-driven reciprocating pumps, which are now in operation. The steam-driven pumping engines in the old engine-house were dismantled and the engine-house is now undergoing alterations to accommodate a third set of oil-engine-driven reciprocating pumps, which it is hoped to have in readiness for the coming summer. Each of the new units is designed to pump 2 million gallons per day. The main contractor for the supply of the machinery is the Lilleshall Company, the engines being made by Messrs. Davey, Paxman. Messrs. F. R. Hipperson and Son are carrying out the alterations to the building necessary to accommodate the new machinery.

IMPROVEMENT OF SUPPLY: SOUTHERN AND WESTERN DISTRICT.

Remodelling of Surbiton Pumping Station.—The work of remodelling and combining the old Lambeth and Chelsea stations at Surbiton is in progress. A part of the old Lambeth buildings was reconstructed to house new pumping plant and boilers, all of which are now being installed. The pumping machinery consists of four steam-turbine-driven centrifugal pumping units of a total horse-power of 4906. The contract for these units is in the hands of Worthington Simpson, Ltd., the turbines being built at the Fraser and Chalmers works. The boiler plant is provided by John Thompson, Ltd., and the coal-handling plant, the erection of which is approaching completion, by Robert Boby, Ltd. The alteration to the buildings is being carried out by Messrs. E. D. Winn and Co. It is anticipated that the turbine units and boilers referred to above will be ready for operation during the coming summer. The demolition of further old Lambeth pumps, the alteration of the buildings housing the same and the installation of new low-lift pumps to raise water from the low-level filters to the suctions of the high-lift pumps will be proceeded with when the trials of the machinery now being erected have been completed.

Remodelling of Brixton Pumping Station.—In connection with the scheme for remodelling the existing pumping station at Brixton a contract was entered into with W. H. Allen, Sons and Co., Ltd., of Bedford, for the supply of six oil engines driving centrifugal pumps of a total horse-power of 880. Tenders were invited for the erection of a new engine-house to house this machinery. The station supplies water to service reservoirs at Norwood, Selhurst, Streatham, Rockhill, Forest Hill and the Crystal Palace.

Walton Pumping Station.—A contract was entered with Worthington-Simpson, Ltd., for the supply of a steam-turbine-driven electrical generator and pumps. The unit is to be capable of pumping, in parallel, 18 million gallons per twenty-four hours into the Molesey Reservoirs, or, in series, 9 million gallons per twenty-four hours into Walton or Island Barn Reservoirs. The turbine will also drive a 150-kilowatt generator.

Hampton Pumping Station.—During the year, the Board decided to replace three direct-acting Cornish "Bull" engines at Hampton with more modern machinery. Two of these engines were used as an emergency supply for intercommunication pumping *viâ* Battersea and were installed in 1854. The third, dating from 1860, was used for pumping unfiltered water on to the high-level filters at the Hampton Works. The machinery to replace the "Bull" engines will consist of a 500-kilowatt oil-engine-driven generator driving two centrifugal pumps, together capable of pumping 12 million gallons per twenty-four hours to the high-level filters, and one centrifugal pump to deliver alternatively in series or in parallel 5 million gallons per twenty-four hours against a head of 300ft., or 10 million gallons per twenty-four hours against a head of 150ft. The order for the supply of the electric generator has been entrusted to Ruston and Hornsby, Ltd., and that for the centrifugal pumps to the Harland Engineering Company, Ltd. The tender of Grace and Marsh, Ltd., for the reconstruction of the building was accepted.

Mains for the Improvement of Supply to Esher, the Dittons and Tolworth.—During the year a contract was entered into with Whittaker Ellis, Ltd., for the laying of 2960 yards of 24in. and 2835 yards of 18in. main from Surbiton to and along the Kingston by-pass road *viâ* Hook-road. The work was completed.

IMPROVEMENT OF SUPPLY: KENT DISTRICT.

The construction of the new pumping station at Deptford was completed and the new machinery installed and satisfactorily set to work. The pumping machinery consists of the following:—

Main Unit.—Vertical triple-expansion steam engine driving four sets of three-throw pumps lifting 7·2 million gallons per day from the well and pumping 8·3 million gallons to the low-pressure zone, 3 million gallons to the intermediate pressure zone, and 1·1 million gallons to the high-pressure zone. The water horse-power is 794.

Standby Units.—Three steam-turbine-driven centrifugal pumps, each capable of pumping 6 million gallons per day 200ft., or 3 million gallons per day 400ft., and a water turbine-driven centrifugal pump capable of pumping 6 million gallons from the well.

Hathorn, Davey and Co., Ltd., are the main contractors, the steam turbines being made by Bellis and Morcom, Ltd. The four water-tube boilers have been supplied by John Thompson, Ltd.

Work was resumed on the extension of three adits to connect the new well with the existing wells. Two of these connections were made, and it is expected to complete the work on the adits in the spring. This operation was suspended during the erection of the new machinery. The working-out mains connecting the new pump deliveries with the existing system of mains were also completed.

Supply to Greenwich and Woolwich.—In connection with the supply from Deptford Pumping Station, a 24in. steel main is now being laid from Deptford to Woolwich, a length of 6050 yards, connections being made *en route* to existing mains. The work was nearly completed. Messrs. J. B. Edwards and Co., are carrying out the main-laying operations.

Supply to Plumstead and North and South Woolwich.—A 30in. diameter cast iron main, 12,000 yards in length, was laid from Honor Oak Pumping Station to Woolwich, where it will connect with an existing 20in. diameter main. This 20in. main passes through the Woolwich footway tunnel under the Thames and connects to the East London area of the Board's Northern District with elevated tanks at Plumstead.

The 20in. main was extended to Plumstead Common, where a new reservoir is being constructed. The laying of the 30in. main has been carried out by Messrs. Wm. Press and Son.

Plumstead Common Reservoir.—A concrete covered service reservoir of approximately 1½ million gallons capacity in extension of the existing service reservoir at Plumstead Common is in course of construction, the work being carried out by J. B. Edwards and Co. (Whyteleafe), Ltd.

Honor Oak Pumping Station.—In order to pump the additional water required through the above 30in. main, it is proposed to install at Honor Oak an oil-engine-driven centrifugal pump capable of pumping 12 million gallons per day against a head of 100ft., or 6 million gallons per day against a head of 200ft. A contract for the supply of this machinery was entered into with Ruston and Hornsby, Ltd.

BOOKS RECEIVED.

Aden Port Trust, Administration Report for 1930–31. Aden: The Port Trust Office.

"Mechanical World" Year Book, 1932. London: Emmott and Co., Ltd., 28, Bedford-street, W.C. 2. Price 1s. 6d. net.

Parliamentary Gazette: General Election Number. London: James Howarth, 21, Elmfield Mansions, S.W. 17. Price 5s. net.

Crysotile Asbestos in Canada. By J. G. Ross. Ottawa: Mines Branch, Department of Mines, Canada. Price 25 cents net.

Modern Milling of Cane Sugar. By F. Maxwell, D.Sc., &c. London: Norman Rodger, 2, St. Dunstan's-hill, E.C. 3. Price 50s. net.

The South American Handbook, 1932. London: Trade and Travel Publications, Ltd., 14, Leadenhall-street, E.C. 3. Price 2s. 6d. net.

Applied Personnel Administration. By J. E. Walters. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 18s. 6d. net.

Wagon Details and Construction. By P. H. Saunders. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 7s. 6d. net.

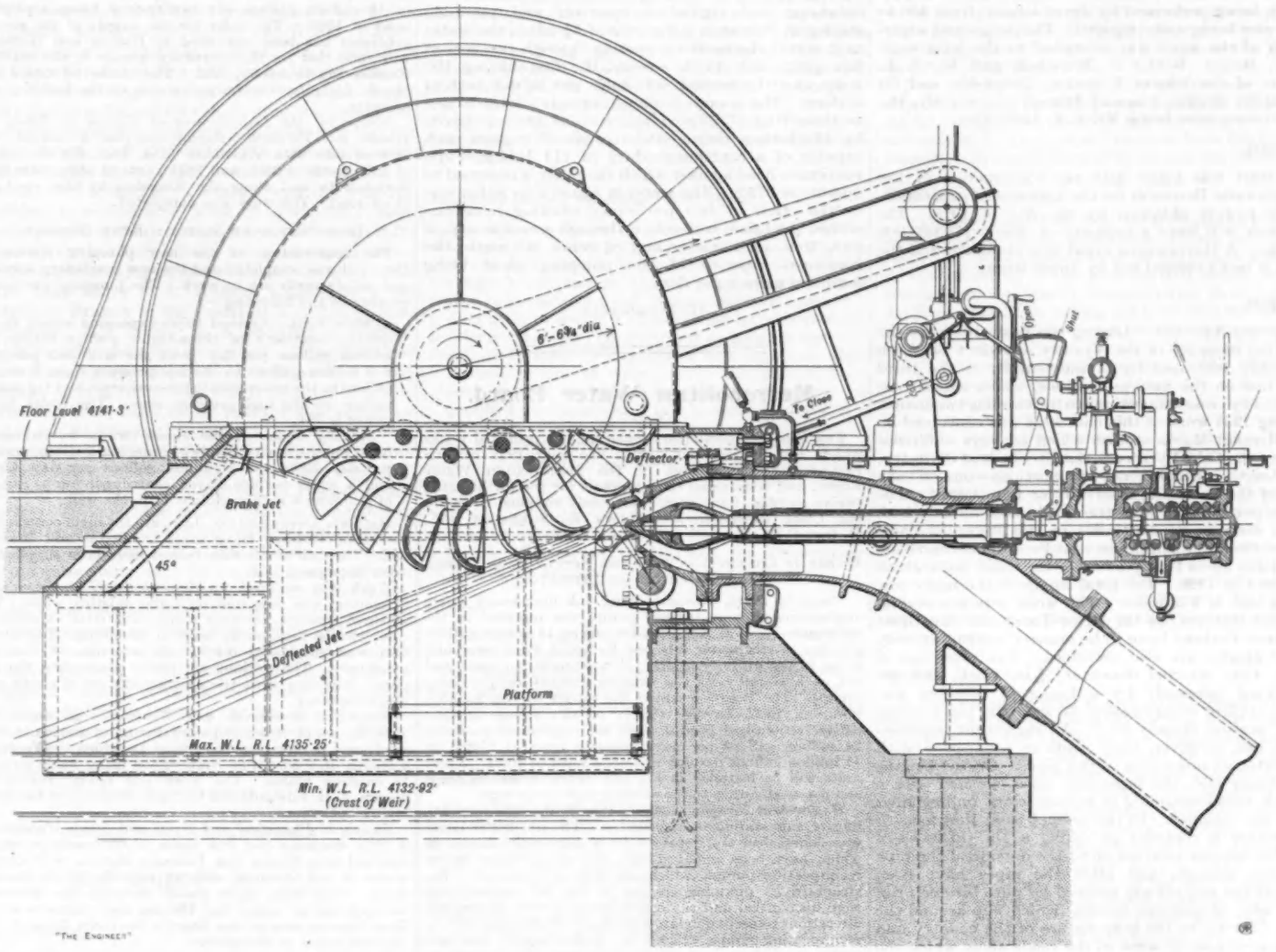
The Practical Electrician's Pocket Book, 1932. Edited by F. H. Robinson. London: Odhams Press, Ltd., 93, Long-acre, W.C. 2. Price 2s. 6d. net.

Estimating for Mechanical Engineers. By L. E. Bunnett. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 10s. 6d. net.

17,000 HORSE-POWER PELTON WHEEL FOR THE PUNJAB

BOVING AND CO., LTD., LONDON, ENGINEERS

(For description see opposite page).



GENERAL ARRANGEMENT OF UNIT

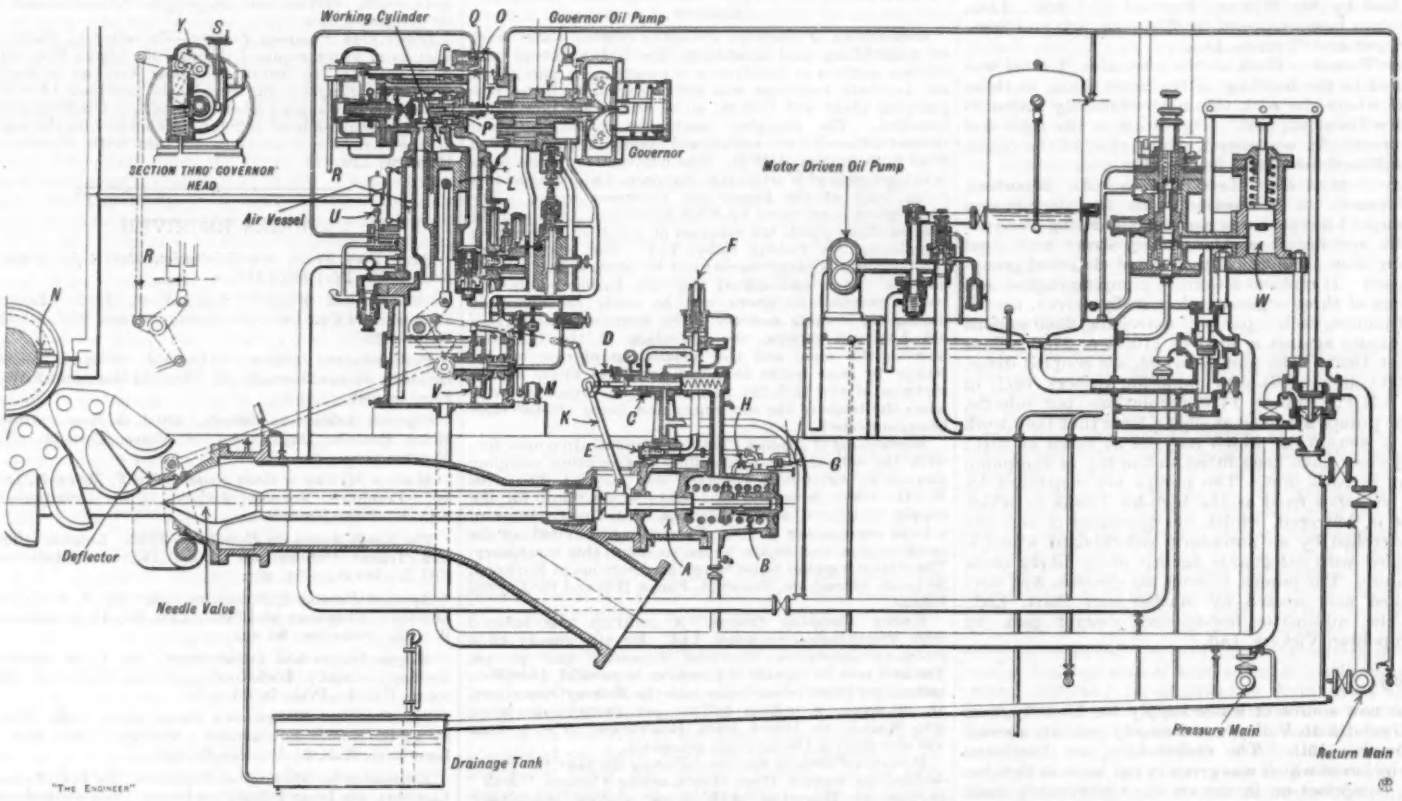


DIAGRAM ILLUSTRATING GOVERNING AND PROTECTING GEAR

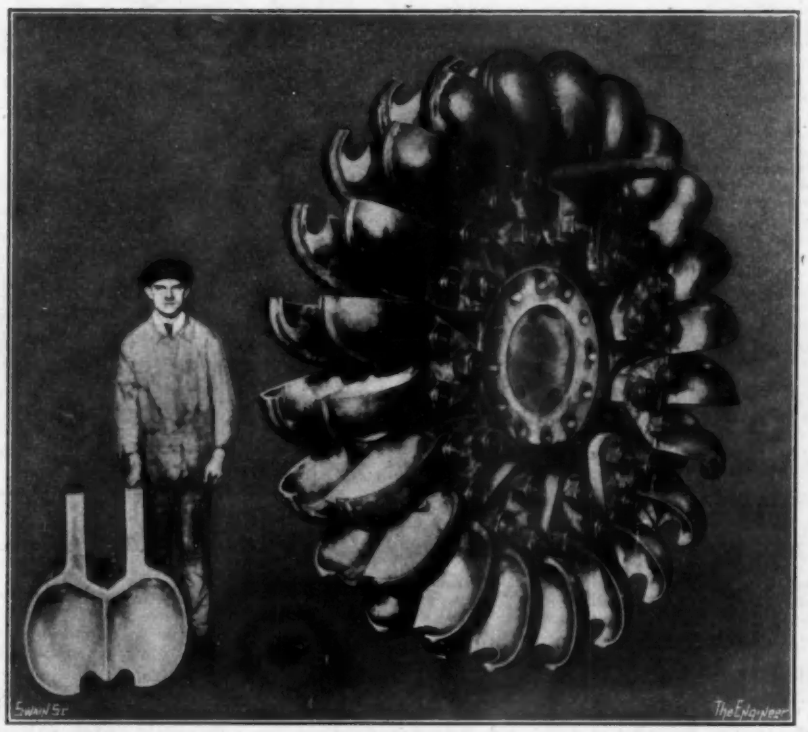
Some Large Pelton Wheels.

SOME hydro-electric units of unusual interest which have just been completed in this country are illustrated herewith and on pages 44 and 48. These machines—there are four of them—are each of 17,000 horse-power, and are claimed to be the largest single-runner Pelton turbines ever made in this country. They are also noteworthy on account of the elaborate arrangements which have been made for their automatic control. This latter peculiarity has been made necessary on account of the fact that they are to be operated in India by native labour, with the stipulation that there should be only one European in command of the plant. As the wheels work under a pressure head of some 2000ft., damage might be caused to the machines, or the pipe line, by the careless manual operation of the controls if they were not automatically governed.

FOUR 17,000 HORSE-POWER PELTON WHEELS

The machines are for the Shanan generating plant of the Uhl River project, in the Punjab, India, and have been made to the designs of Boving and Co., Ltd., of 56, Kingsway, London, by Markham and Co., Ltd., of Chesterfield. The generators which they drive are by the British Thomson-Houston Company, Ltd., of Rugby, while some of the governor gear has been supplied by Verkstaden, Kristinehamn, Sweden, who are associated with Boving and Co. The inspection of the turbines has been carried out by Messrs. Preece, Cardew and Rider, of Westminster.

As will be seen from the general arrangement drawing on page 48, each unit comprises a single-runner Pelton wheel, with a single jet, which is overhung on the end of the generator shaft. It is capable of developing 17,000 horse-power continuously when running at a normal speed of 428·5 revolutions per minute, under an effective head of 1668ft. The wheels will, however, ultimately be worked under a head of 2001ft., when a dam in the river has been raised; but the output developed will still be restricted to the same amount and the quantity of water consumed reduced.



ASSEMBLED WHEEL

By adopting the overhung principle it has been possible to provide a machine which will be very easy to line up on the site where it is erected. There are only two bearings, each of the Michell type, with the alternator in between, the Pelton wheel overhung at one end, and the exciter at the other. The arrangement naturally involves a rather heavy shaft, but it has been kept down to 21in. in diameter, which, considering the comparatively slow speed for such a power, seems to us quite moderate.

The wheel is built up of a solid steel disc 6ft. 6¾in. in diameter, to which there are bolted twenty-two buckets. These buckets are cast in pairs, with lugs that embrace the disc, and each pair is held by three bolts. The reason for making the buckets in pairs and sharing the lugs is that if each bucket had its own lug, each lug would require two bolts and there would not be sufficient room round the circumference of the disc for their accommodation. The arrangement naturally involves a very pretty piece of casting work, in making the buckets, and we must congratulate Thos. Firth and John Brown, Ltd., of Sheffield, on their production. They are cast in stainless steel, and we understand that out of the four sets of twenty-two buckets only one waster was produced. That one was discarded on account of a blow-hole, but served a useful purpose in providing test pieces. The tests showed a tensile breaking strength of 59·4 tons, a yield point of 39·6 tons, and an elongation of 22·9 per cent., with a reduction of area of 42 per cent. The buckets, a pair of which we illustrate in detail, were very carefully machined so that their lugs straddle the central disc exactly, and are held in place by bolts with a slight taper. The nuts of the bolts are prevented from slacking back by folded up washers and a small "tack" of electric welding.

The interior of the buckets was ground out by a hand-operated wheel, burnished, and the rib which splits the water jet brought up to an edge almost as sharp as that of a carving knife. After assembly the wheels were all sent to the B.T.H. works, mounted on their shafts and run up to speed with the generator acting as a motor. In this manner they were balanced and we noticed that, although their total weight is over 7 tons, only a few pounds of balancing weight had to be added in the worst case of the four wheels. After balancing the wheels were run up to double speed, which is, of course, more than the run-away speed of a Pelton, for five minutes, to test them for centrifugal strength. This matter is not, however, of very great import in connection with the turbine, as the centrifugal stresses produced by over-speed are far more dangerous in the generator than in the water-wheel. It is the impact of the water jet on the buckets which produces the major stresses in the wheel.

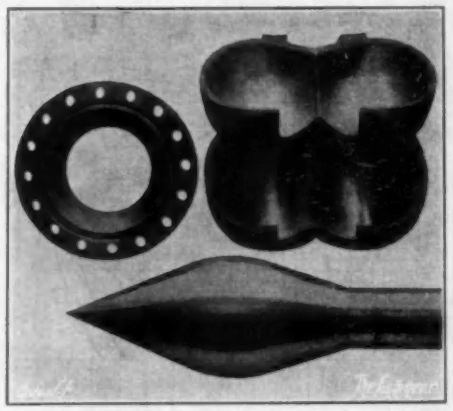
The jet has a maximum diameter of 204 mm. (say, 8in.) and emerges from a stainless steel orifice. This orifice is of forged material and is bolted to a cast steel nipple on the end of the inlet bend, so that it can be easily renewed. The inlet bend is fixed to the bed-plate by a split ring to permit of its easy removal.

The needle valve, which is used to control the size of the jet, is also of cast stainless steel, with a forged stainless steel point, and is carried by a stainless steel stalk, which works in a bronze bushing and is protected by a galvanised steel tubular casing. The materials have been so chosen as to minimise electrolytic action.

The casing in which the wheel runs is a combination of the cast iron bed-plate and a skirt of sheet steel, which will be completely embedded in the concrete foundations, with a top casing of light steel plating electrically welded together. Within the lower part of the casing there is a grating on which a man can stand conveniently to attend to the nozzle mechanisms when the machine is out of commission, and for this purpose he gains access through a manhole in the top casing. Inside there is ample room to move about.

The control of the turbine is effected by a combined action of deflecting the jet away from the wheel and its restriction, by means of a needle valve, gradually, and in such a manner, that the pipe line is not subjected to the shock of taking up the impetus of the moving column of water. In other words, if the load on the set is reduced the jet is immediately deflected from the buckets and the needle valve then gradually reduces the size of the jet to that appropriate to the load. The deflector is then again clear of the jet on account of its reduction in diameter. On an increase in load the needle valve opens the jet again at such a speed as is compatible with the safety of the pipe line.

It has been guaranteed by the makers that if half-load is suddenly thrown off the momentary rise in speed will not exceed 3½ per cent.; for three-quarters load 5½ per cent., and if the full load of 17,000 horse-power is abruptly lost the rise in speed will not be more than 7 per cent. The hydraulic efficiencies which have been guaranteed are shown in the curves which we reproduce, and they are to be confirmed on the site by the Ott current meter method.



BUCKET UNIT, NEEDLE VALVE AND ORIFICE

The governing of each turbine is done by a sensitive "pendulum" driven by an endless belt from the generator shaft. The pendulum, which is part of a standard governor, controls by means of oil under pressure, through its own regulating valves and servomotor, the movement of the deflector acting on the jet. Indirectly, through the governor regulating shaft, it also controls the movement of the needle controlling the size of the jet. The pressure oil is supplied by a separate motor-driven pumping unit, one for each turbine. There is also, within the governor, a second oil pump which is generally used for lubricating purposes, but may also be used for providing the pressure oil for actuating purposes. The two pumps are plainly marked on the drawing.

Provision in the governing gear is made to cover the following features:—

(1) Remote control of the speed of each set from the switchboard.
(2) Hand control of the deflector and needle.
(3) Limitation, by hand adjustment, of the output to a maximum of 17,000 B.H.P.
(4) On failure of oil pressure in one pumping set, that set is automatically isolated and the turbine

concerned is immediately and automatically fed by the spare pumping set.

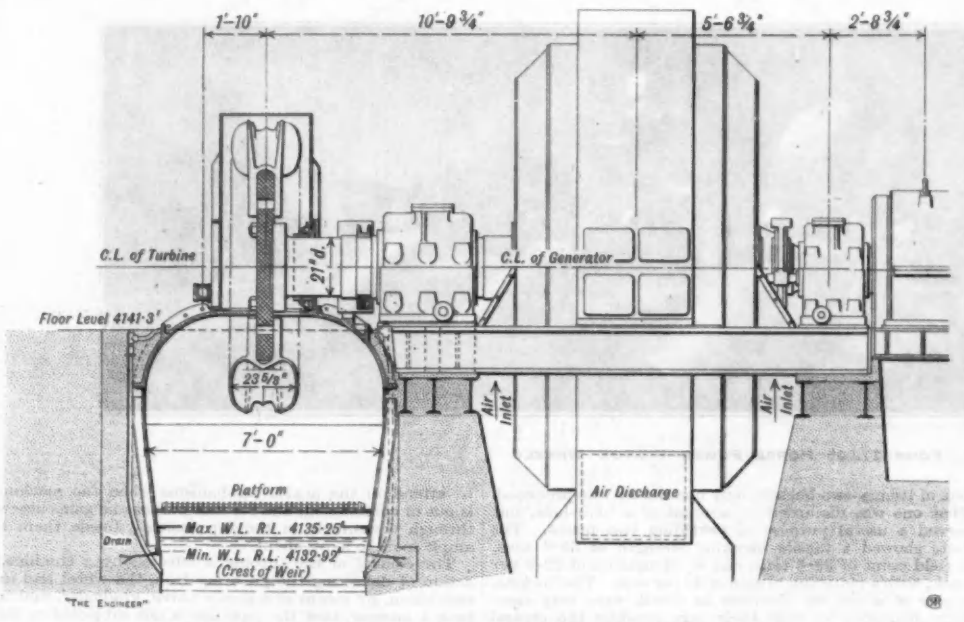
(5) On complete failure of oil pressure, including that from the spare source, both the needle and deflector are immediately locked in the position they each occupied when failure occurred.

(6) When the deflector is so locked its movements can be controlled from the switchboard by means of a motor.

(7) On the occurrence of over-speed the deflector is immediately closed, either by pressure oil, or if that is not available, by an electric motor in five seconds.

(8) There is also gear to make it possible to by-pass water surplus to what is required for the load to other plant in the tail-race.

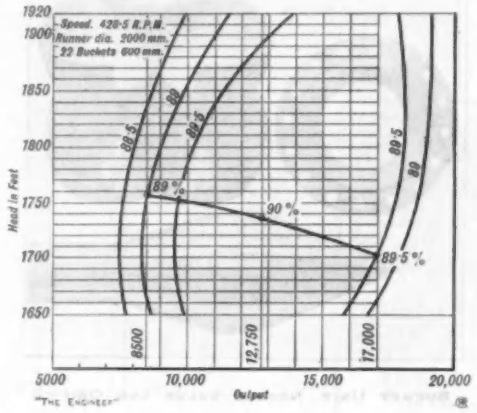
(9) The speed of the sets is adjustable between no-load and full load to ensure an even balance of load between the units when running in parallel.



GENERAL ARRANGEMENT OF PELTON WHEEL AND GENERATOR

The attainment of all these requirements naturally involves a rather complicated mechanism, and although the drawing of it which we give at the bottom of page 48 appears formidable, the actual appliance looks comparatively simple, as may be gauged by the photographic illustrations.

The speed of the machine is controlled in normal circumstances by the centrifugal pendulum, which comprises a pair of weights encased in a pulley driven by belt from the main turbine shaft. These weights are free to swing outwards, under centrifugal action, against the resistance of a spring, and in doing so roll over the inner face of the pulley. At the same time they move the governor spindle by means of thin steel straps wrapped round them. The



EFFICIENCY CURVES

result is that there is no sliding friction in the mechanism and it is very sensitive to changes in speed.

The spindle is continued by the pin valve T, which controls the supply of oil, under a pressure of about 150 lb. per square inch to the relay sleeve valve P. This supply of oil can be obtained from the gear pump, marked "governor oil pump," driven directly by the governor, or, alternatively, from the motor-driven oil pump of its own individual set, or from the pressure main which interconnects all the four units.

The movement of the pin valve by the governor, actuates the larger sleeve valve and admits oil under pressure from the air vessel to the working cylinder L, which actuates the jet deflector by the bell-crank and linkage shown. Simultaneously, two other actions take place, as there are two other connections with the bell-crank shaft. One marked R.R. tends to restore the sleeve valve to its normal position, and the other energises the servomotor of the needle valve.

The needle valve, it should be pointed out, is closed by the spring B and is opened by the pressure of oil against the piston of the servomotor A.

The supply of pressure oil passes through the regulating valve C, the locking valve F, and the timing valve E to the servomotor. The timing valve is pierced with small holes, which are so proportioned that the supply of oil provided to the servomotor will be such that the needle valve cannot be closed more quickly than is safe for the pipe line. The locking valve is provided against the emergency of the oil pressure in the piping system being lost. This valve is then closed, automatically, by its spring, and the servomotor cylinder is then hermetically closed, so that the conditions remain unchanged until interfered with by hand. The pump G provides a means of moving the needle by hand, but even if the oil pressure is totally lost the little motor M can be used for manipulating the deflector from the switchboard.

It will be noticed that in the linkage connecting the main shaft and the servomotor valve, there is a link K, which tends to return the valve to the normal position as the needle valve moves. There is also a little stop D, which can be adjusted to regulate the travel of the valve, and allow water to be passed through the nozzle, regardless of the load, and be deflected into the tail-race for the supply of the lower reaches of the river.

There is another precaution against the emergency of the governor gear becoming inoperative, in the motor marked M. If the oil pressure should fail a clutch V is thrown into gear and then the deflector can be operated either by this small motor controlled from the switchboard or by a hand wheel locally.

Should the machine run away the trigger N will open an electric circuit and the solenoid U will open a valve that will relieve the oil pressure behind the plunger Q, which, by acting on the lever O, pushes the governor valve into the closing position and the machine shuts down.

There is an adjustment for speed regulation at Y, which can be operated either locally by hand, or by a small motor from the switchboard, by altering the oil passages of the main valve.

There is, finally, one other precaution against the failure of the oil supply to any one set. As we have mentioned, all the sets are interconnected by mains. Normally each set runs independently, but the oil vessel of the spare set is always kept under pressure, so that, should any one of the other sets fail, the double-beat valves shown on the right of the drawing will change over, and that supply of oil can be drawn upon until things are put right.

We have not been able, in the scope of such an article as this, to refer to many parts of this equipment, but it seems to us to be one of the most elaborately protected that could be devised.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

MILLING CUTTERS AND REAMERS.

No. 122—1931. This is a revision of the British Standards for Milling Cutters and Reamers (B.S.S. No. 122), which was first published in 1920. The revision was undertaken in order to make certain modifications which had become necessary as a result of changes in practice. It was felt that a somewhat bigger key was desirable in the case of the larger diameter arbors and the Tables of Dimensions for Keys and Keyways for Arbors have therefore been amended and extended to provide for arbors up to 5in. in diameter.

There has been an increasing tendency to use longer gear-cutter hobs than those specified, particularly in the case of hobs of small diameters, and the Table of Dimensions of Hobs has therefore been revised, whilst the Table of Hand Taper Pin Reamers has been correlated with the table of dimensions of taper pins in B.S. Specification No. 46, Part 3.

One of the most important features of the revision is the addition of standard dimensions for milling machine spindle noses and arbors of two sizes, together with the dimensions of adaptors for using old pattern arbors in the new spindles.

Shipbuilding and Marine Engineering in 1931.

No. II.*

Improvements in Propelling Machinery.

IN outlining in our last article the principal ships built and engined in 1931 we touched upon some of the more outstanding installations of steam and motor propelling machinery. In what follows we make further reference to the progress made in the different branches of marine engineering, including in our survey one or two special naval machinery installations, the designs and performances of which will inevitably react on merchant marine practice. The outstanding machinery performance of 1931 was, as already recorded in our first article, the world record in steaming made and maintained by the Canadian Pacific liner "Empress of Britain," which is 0·57 lb. of oil per S.H.P. hour for all purposes, including the hotel load. Mr. John Johnson, the chief superintendent engineer of the Canadian Pacific Railway Company's steamship undertakings, is to be warmly congratulated on the success which has attended the machinery designs for this ship, which were initiated

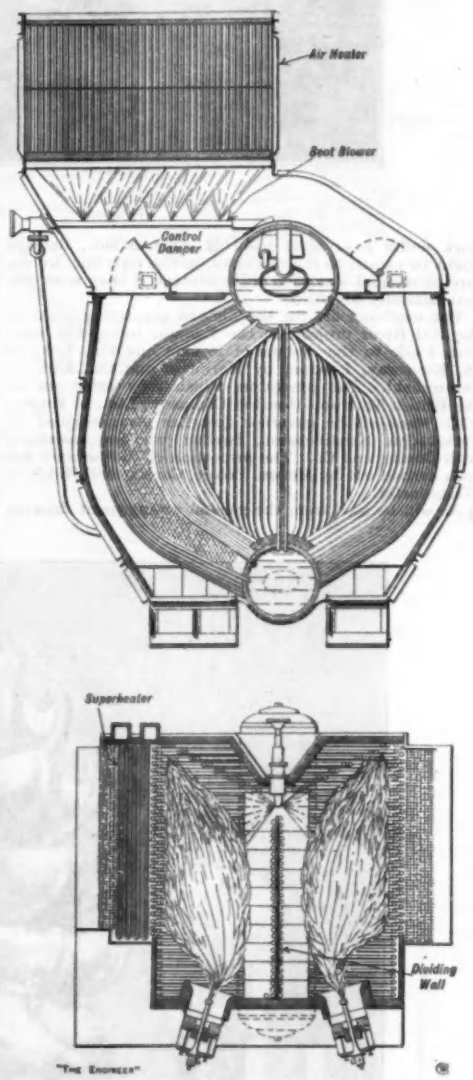


FIG. 9—SECTIONS OF JOHNSON BOILER

by him and carried out by the builders under his personal supervision.

Another fuel record was that made by the British destroyer H.M.S. "Acheron," which was built and equipped with boilers by John I. Thornycroft and Co., Ltd., and engined by the Parsons Steam Turbine Company, Ltd., of Wallsend-on-Tyne, with geared turbine machinery designed to work with steam supplied at a pressure of 500 lb. per square inch and with 750 deg. Fah. total temperature. On her trials the "Acheron" set up a new record for naval vessels, the oil consumpton on the full-power trial being 0·608 lb. per S.H.P. hour for all purposes, when the boilers were burning 0·785 lb. of oil per square foot of heating surface, the consumption of water being 7·77 lb. per S.H.P. hour. In comparing these results with modern liner practice the fact must be borne in mind that the naval boilers would have a materially higher efficiency at a reduced fuel consumption, while the funnel gas temperature of 600 to 700 deg. Fah. of naval practice is very different from that of 200 to 300 deg. Fah. which is usual for a modern liner. A full description of the machinery of the "Acheron"

* No. I. appeared January 1st.

was given in our issue of June 26th last. With reference to 500 lb. pressure marine plant, we may state that during 1931 the "King George," equipped with Parsons turbines and Babcock boilers, completed her third season of steaming with entire success.

An interesting installation from the point of view of running economy was the critical pressure Benson boiler on the Hamburg-Amerika liner "Uckermark," already referred to in our last week's article—see page 9—on the progress in prime movers. The results showed that a boiler efficiency of 90 per cent. was easily obtained and that, using oil fuel, about 0·47 lb.

FIG. 10—YARROW BOILERS UNDER CONSTRUCTION

of oil was required per S.H.P. hour. The saving in both weight and space and the high fuel economy were held to be such that the high-pressure turbine installation could compete fully with the oil engine. It was found, however, that the economic gain using the super high pressure was only about 10 per cent. more than that with boilers operating at about 440 lb. pressure. The Benson boiler would appear to be most attractive for the larger ships with machinery over about 15,000 S.H.P., for which the space and weight saving would be considerable. In view of the difficulties of operation and the increased complication, the system is thought by some to be unlikely to commend itself for small and medium-sized ships.

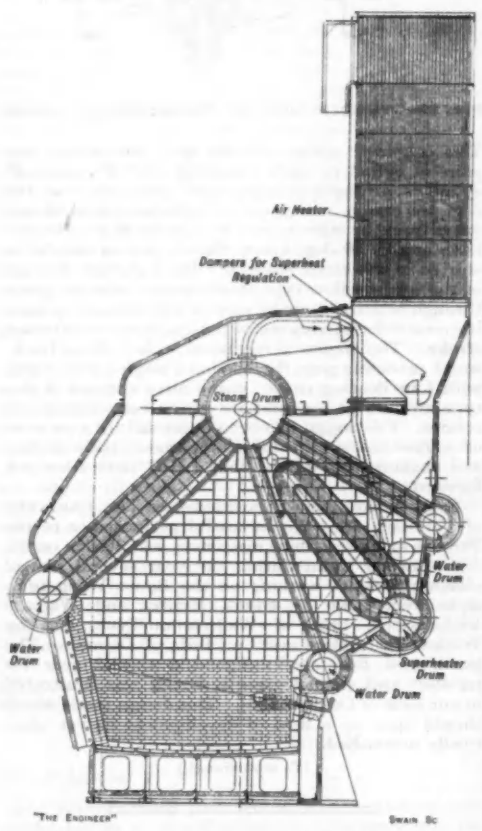


FIG. 11—SECTION THROUGH YARROW BOILER

Progress in Boiler Design.

In our article of a year ago we dealt fully with the "Johnson" boilers which were installed on the C.P.R. liner "Helene" and the "Empress of Britain." During the past year excellent results have, we learn, been obtained with these two boilers. On the "Helene" the Johnson boiler has on several occasions supplied the whole of the steam for propulsion with easy and reliable operation, while on the "Empress of Britain" the Johnson boiler has supplied its full quota of steam production.

Early in the year Clarke, Chapman and Co., Ltd., acquired the manufacturing and licence interests relating to the Johnson boiler, and work was carried out in collaboration with Mr. Johnson in the direction of applying the experience already gained to the design of improved types of boilers for mercantile and naval use. We illustrate in Fig. 9 a new boiler which is now in course of construction at Gateshead and will be steamed as a demonstration unit in Messrs. Clarke, Chapman's works. The large cylindrical combustion chamber carefully proportioned to give the requisite travel and time for the complete combustion of the fuel before the egress of the gases has been retained. Highly preheated air is used and, as our drawing shows, the arrangement of the air heater the superheater and the controlling dampers. One feature to which attention may be called is the small amount of brickwork employed, which, the designers' claim, enables the boiler to meet increases in rating without any refractory troubles. The furnace has been carefully designed to avoid any undue stresses in the fire-row tubes. Experience with the two boilers already at sea has indicated that the Johnson boiler has a very useful manœuvring characteristic, especially when steam may be required to be immediately shut off. The very small amount of heat which can be stored in the refractories allows steaming to be reduced or shut off at short notice. The superheater has been so arranged that an equal flow of steam is given through all tubes, while questions of ease of erection and dismantling have been carefully taken into account. The trials of this new boiler will be awaited with interest.

Throughout the year the shops of Yarrow and Co., Ltd., at Scotstoun, were busily employed. In Fig. 10 we show a view of one of the four large 69,000-lb. Yarrow water-tube boilers installed in the P. and O. liners "Strathnaver" and "Strathaird." Alongside it is a 3000-lb. Yarrow boiler constructed for service abroad. These large units show a saving of over 60 per cent. in floor space compared with earlier types, and they have the additional advantage of giving a simpler pipe arrangement, fewer fittings, and a reduced stokehold staff. Attention may be called to the regulating dampers for the superheat, which are a new feature and are clearly shown in the sectional drawing reproduced in Fig. 11. They are fitted in the uptakes to the air heater. When the damper leading to the superheater side of the boiler is closed and the other damper open, practically the whole of the gases go up that side of the boiler remote from the superheater. On the other hand, by opening the damper on the superheater side and closing the other, nearly the whole of the hot gases flow past the superheater elements. The two dampers are interlocked, so that the operation of opening the one closes the other. The degree of superheat can thus be readily controlled over a wide range, and in operation on the "Strathnaver" this device has proved to be most successful, the boilers showing a remarkable flexibility, both as regards steaming and superheat control.

In addition to supplying the above-mentioned boilers, Yarrow and Co., Ltd., built boilers for the P. and O. liners "Corfu" and "Carthage," and supplied designs for boiler installations for the new Cunard liner, the P. and O. liner "Strathaird," the Italian liner "Conte di Savoia," and an Italian aircraft carrier.

At Renfrew considerable work was done in developing new types of boilers for naval and mercantile service. We illustrate in Fig. 12 the new sectional express type of boiler for the H.M.S. "Guardian," a combined net layer and target towing vessel now being built by the Admiralty at Chatham Dockyard. Drawings of this boiler were given in our issue of September 25th last. It has a designed output of 91,000 lb. of steam per hour, a heating surface of 5850 square feet, and a working pressure of 250 lb. per square inch. The floor space occupied is 138 square feet and the steam output works out at 650 lb. per square foot of floor space. Our left-hand illustration clearly shows the arrangement of headers and water drums with the curved tubes, while to the right of Fig. 12 a view of the completed boiler is shown. It is equipped with standard Admiralty type oil burners and steaming trials are now being carried out at Renfrew. The preliminary trials showed, we understand, the easy steaming of the boiler and its good performance at varying fuel rates. A mechanically fired 1575 lb. pressure boiler at Renfrew with 850 deg. Fah. superheat, was also successfully steamed.

An outstanding ship of the year was the "Monarch of Bermuda," referred to in last week's article, which was equipped with Babcock 400 lb. pressure boilers working in a closed stokehold with the very low air pressure of 1½ lb. per square inch. Towards the end of the year Babcock and Wilcox, Ltd., received orders from Vickers-Armstrongs, Ltd., for the boiler parts for the sister liner. Among cross-channel steamers in which Babcock boilers were installed during the year we may mention the "Princess Josephine Charlotte" for the Belgian mail service; the "Princess Margaret" for the L.M.S. Larne-Stranraer service; and a sister ship to the "Slieve Bloom," completed by Denny Bros. in 1930 for the L.M.S. Railway Company, now under construction at Dumbarton.

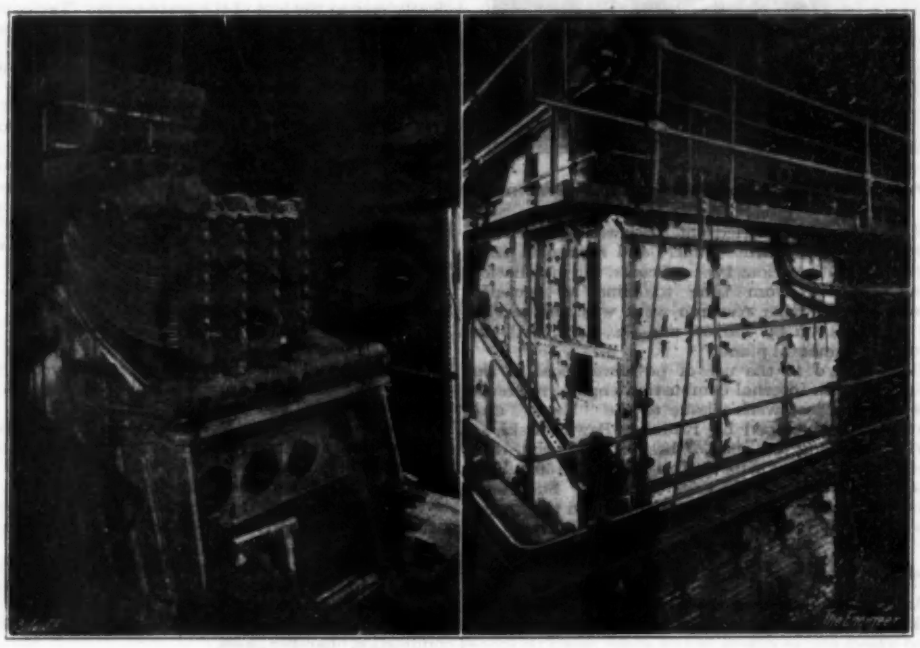


FIG. 12—BABCOCK AND WILCOX EXPRESS SECTIONAL BOILER FOR H.M.S. GUARDIAN

Pulverised Fuel Progress in 1931.

During the year 1931 some interesting results of the marine pulverised fuel installations were published. At a recent meeting of the Schiffbautechnischen Gesellschaft Dr.-Ing. E. H. Goos gave an interesting comparison between the hand-fired steamer "Bitterfeld" and the pulverised fuel-fired steamer "Stassfurt." On similar seventy-five-day voyages he estimated the daily coal consumption to be 79½ tons and 76 tons respectively, which resulted in the case of the "Stassfurt" in a yearly saving of 57,000 marks.

These two ships are of the same class, and were constructed for the Hamburg-Amerika Line. Dipl.-Ing. Koch, the technical director of the Norddeutsche Lloyd, also gave some useful figures concerning the recent performances of the "Donau," which was equipped with the Resolutor pulverised fuel system of firing two and a-half years ago. He stated that a saving of 11 per cent. over hand firing has been obtained, and his company was prepared to proceed with the adoption of the same system of firing in any future vessels of that type it might build.

Valuable results concerning the performance of the s.s. "Musician" and the s.s. "Recorder," the boilers of which ships are equipped with the Clarke-Chapman pulverised fuel system of firing, were published in THE ENGINEER of October 30th last. The "Musician," which was partially converted for burning pulverised fuel in 1929, has now a coal consumption of approximately 30 tons per day, compared with a hand-fired consumption of 35 tons per day before her conversion; while the "Recorder," which was specially built for the Clarke-Chapman system of firing, has a coal consumption figure of 1·27 lb. per I.H.P. hour.

Perhaps the most complete record yet published was given in the early part of 1931—see THE ENGINEER of March 27th—by the Berwind-White Coal Mining Company. It describes fourteen months' performance of the pioneer pulverised fuel fired ship the "Berwindlea," which, for the whole of the period under review, gave a coal consumption of 1·28 lb. per I.H.P. hour.

At Gateshead Clarke, Chapman and Co., Ltd., are now engaged in the execution of contracts for the pulverised fuel equipment for two Japanese steamships, particulars of which contracts have already been given in our columns.

With their experimental plant at Renfrew, Babcock

FIG. 13—TAYLOR STOKER FOR S.S. BEAVERHILL

and Wilcox, Ltd., carried out further trials with the 550 lb. pressure marine boiler, and successful tests were made with various types of coals, the installation being steamed from time to time as occasion demanded. Further research work was also carried out at Scotstoun by Yarrow and Co., Ltd., with the firm's experimental plant.

With regard to the use of powdered coal in the cylinders of an internal combustion engine, reference was made in last week's issue to the "Rupa" coal dust motor developed by Rudolph Pawlikowski, of Görlitz. During the year a three-cylinder coal dust engine of the marine type with an output of 150 B.H.P. was built and run at Elbing, Germany. Successful runs over several weeks were recorded and the engine was inspected by representatives of British firms.

Mechanical Stokers at Sea.

An outstanding feature of coal-burning progress in 1931 was the successful operation at sea of several

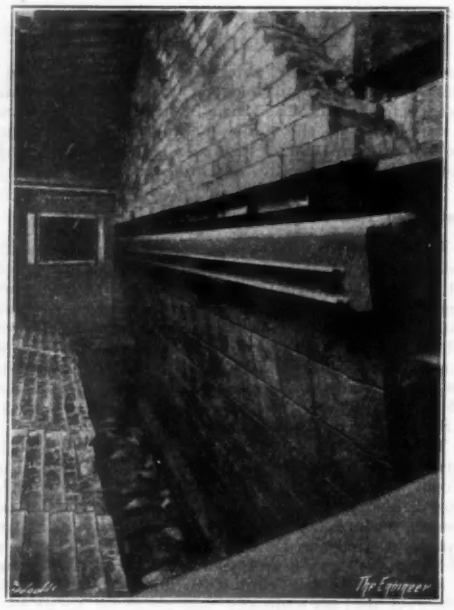


FIG. 14—REAR WATER-WALL OF FURNACE

mechanical stoking plants. The "Beaver" class of Canadian Pacific cargo ships were particularly noteworthy in this connection. When commissioned, it will be recalled, the C.P.R. steamers "Beaverhill" and "Beaverbrae" were hand-fired, both vessels having Babcock boilers. The other three ships of the same class have Yarrow boilers, equipped with Erith-Roe mechanical stokers during construction. The results of these ships, we are given to understand, were sufficiently satisfactory over a period of three years to warrant fully the equipping of the two remaining ships. The "Beaverhill" was accordingly fitted with mechanical stokers of the Taylor type, whereas, in the "Beaverbrae," the Erith-Roe type was installed. Both vessels have now made several voyages using "run-of-mine" coal, registering a boiler efficiency of about 82 per cent. Arrangements have been completed whereby a large range of bituminous coals may be employed in these ships, the additional latitude in the selection of coal having had obvious advantages in the matter of purchasing of fuel. All five vessels are now exhibiting a performance which, in point of uniformity of speed, absence of smoke, efficiency and closeness of control, is regarded as being quite comparable with the results obtained with liquid fuel.

In Fig. 13 we show one of the Taylor stokers erected in the Blaydon-on-Tyne works of the Taylor Stoker Company, Ltd., of Bush House, London. The stoker is of the retort type, with a slag-crushing roller at the foot of the grate, which can be clearly seen in Fig. 13. The control of the fuel bed is effected by adjusting the working strokes of the mechanical pushers and the extension grates, such adjustments being made at the front of the stoker. A variable speed motor and gearbox operating the stoker provides a range of no less than twenty-five different speeds. Fig. 14 shows a view in the furnace chamber, illustrating the metal-clad water wall, which, we believe, is one of the first water walls to be used aboard a ship. The header, which is made of §in. thick forged steel, is furnished with two ribs for collecting any slag so protecting the header. The crushing roll will be clearly seen at the foot of the grate below. The boilers operate at a pressure of 250 lb. per square inch, and they have a steaming capacity of from 16,000 lb. to 21,000 lb. per hour, corresponding to power outputs of 6500 to 8000 S.H.P.

In addition to the Erith-Roe stokers installed in the "Beaverbrae," above referred to, further stokers of the same type were fitted to the existing Babcock boiler in the L.M.S. Railway steamer the "Duke of Lancaster." Although one or two successful voyages were made, extended experience was prevented by a fire on the ship, which is still in Heysham Harbour and has yet to be refloated and reconditioned.

Superheating and Superheater Progress.

Considerable interest was taken in the question of higher superheat temperatures during the year, and several installations were completed with final temperatures of 600 deg. to 750 deg. Fah. At Wallsend-on-Tyne, the North-Eastern Marine Engineering Company, Ltd., supplied marine superheaters for 100 boilers, aggregating 90,000 I.H.P. Most of these were of the standard smoke-tube type, but, in several cases, the superheater elements were extended into the combustion chamber, a higher final steam temperature thus being obtained. This type of superheater, which was first installed in Canadian Pacific steamers, has given good results and experience has shown no deleterious effect on the metal of those superheater elements in contact with the combustion chamber gases.

On two ships, one British and the other French, independently fired superheaters were installed by the Superheater Company, Ltd., while the same firm supplied its patented uptake superheaters for a lower degree of superheat to the two whaling ships, the "Vestfold" and the "Svend Foyn," built by the Furness Shipbuilding Company, Ltd., and engined by Richardsons, Westgarth and Co., Ltd. Uptake superheaters of the patented design of T. Sugden and Co., Ltd., were fitted on the Burmah Oil Company's tanker "Singu," built by Swan, Hunter, and engined by the Wallsend Slipway Company, Ltd. The boiler installation comprises three 17ft. 3in. diameter 12ft. Scotch boilers, with a designed working pressure of 225 lb. per square inch. On the steamship "Recorder," belonging to the Harrison Line, Sugden uptake superheaters were also fitted, and in this case the three boilers were 16ft. 3in. diameter with a length of 12ft., designed for a working pressure of 210 lb. per square inch. We are given to understand that this ship is the only one in which superheaters have been fitted to Scotch boilers working on pulverised fuel. After twelve months' service the installation has been reported to be most satisfactory, the design of superheater showing itself, we understand, to be well adapted for use with powdered coal firing.

An interesting ship completed during 1931 was the "Trione," built by the Lindholmen Yard for the Unda Shipping Company, Ltd., of Gothenburg. She is propelled by a triple-expansion engine of the Lentz type, operating in conjunction with an exhaust turbine. The main steam is superheated in a smoke-tube superheater, but between the H.P. and I.P. cylinders an electrical superheater is fitted which raises the steam entering the I.P. cylinder to 480 deg. Fah. It is expanded in the L.P. cylinder to about 4·2 lb. per square inch absolute, and is then utilised in a low-pressure exhaust turbine down to the condenser vacuum. The installation is a very economical one, and 200 to 300 B.H.P. is generated in the exhaust turbine, which drives a generator supplying auxiliary current for pumps, fans, and lighting, &c., also power for the electrical superheater. The "Trione" is a 3000 gross ton steamer, and she only uses about 6·53 tons of coal per day for a speed of 9·56 knots, which constitutes a record performance for a cargo ship of this particular type.

Reciprocating Engines and Exhaust Turbines.

The question of improved marine steam reciprocating engines and whether the extra cost of improved engines is justified by their performance was the subject of a symposium at the North-East Coast Institution of Engineers and Shipbuilders at Newcastle early in December. The subject proved to be one of considerable interest, and the full discussion of the various papers under review will be continued this month. Mr. J. N. Hendry introduced the subject, and statements of engine design and performance were submitted by William Beardmore and Co., Ltd., of Dalmuir, for the Beardmore poppet valve engine with Caprotti valve gears; the Christiansen engine, by Mr. W. A. Christianson, for Christiansen and Meyer, of Harburg-Wilhemsburg, Germany; the Lentz engine, by John Dickinson and Sons, Ltd., of Sunderland; and a superheated marine steam reciprocating engine, by the North-Eastern Marine Engineering Company, Ltd., of Wallsend; a separate statement on the possibilities of a steam engine of normal design being submitted by the Wallsend Slipway Company, Ltd. As practical experience has been gained with most of the engines discussed, the final analysis will be a valuable one. Our readers are familiar with the Caprotti and Lentz designs, but we may briefly describe the less familiar Christiansen and Meyer design, which is illustrated in Fig. 15.

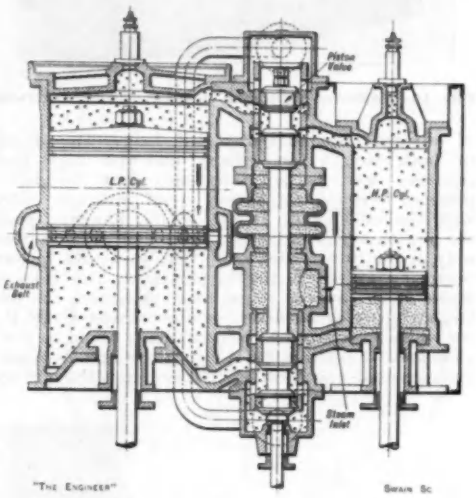


FIG. 15—CYLINDER UNIT OF CHRISTIANSEN NGINE

This engine is a four-cylinder unit, comprising two pairs of cylinders, each consisting of H.P. and L.P. cylinders, arranged in compound, with cranks at 180 deg., the cranks of each pair of cylinders being 90 deg. apart from the other pair. As the two H.P. cylinders have cranks 90 deg. apart, the engine can easily be started in any crank position. The L.P. cylinders are of the semi-uniflow type, with central exhaust ports, through which the main part of the exhaust passes, the remainder passing out of the end port on the return stroke. The engine is furnished with a Klug-Hackworth reversing gear, there being a single-piston valve with four floating rings. Some forty engines of this type are now at sea, and are giving very economical results. The design has been approved by a number of engine builders in different parts of the country, and engines from 350 to 2509 I.H.P. have been put forward.

Early in the year we recorded—see THE ENGINEER of February 6th—the successful performance of the Parsons exhaust turbine machinery installation on the "Kingswood," and during the year several sets of exhaust turbines working on the Bauer Wach principle were built by Swan, Hunter and Wigham Richardsons, Ltd., of Wallsend-on-Tyne, and by William Beardmore and Co., Ltd., of Dalmuir. The last-named firm also designed a special gear for trawlers and smaller vessels, which was illustrated in our issue of October 23rd. This design is one which should open up a field of development as yet practically untouched.

(To be continued.)

ACCORDING to H. E. Smith, of the New York Central Lines, who deals in *Industrial and Engineering Chemistry* with the use of paints on the United States railways, a priming coat of red lead and oil before the bridge members leave the shop is almost universal. Red lead of 98 per cent. conversion is the more convenient, because it may be obtained and kept ground in oil. Mr. Smith favours the addition of 3 or 4 per cent. of lampblack, with the idea of giving the film more toughness; but he points out that opinion is divided on this point. It is also possible to "extend" the red lead by adding half its weight of an inert mineral, preferably asbestine. This addition reduces the tendency to rapid settling of the pigment, and makes the paint work more smoothly under the brush. It is, however, more often used in painting goods trucks than bridges.

Harbours and Waterways in 1931.

No. I.

AT the time when our last annual review of harbours and waterways was penned one of the chief anxieties of the Government was the stimulation of employment by inducing local and other authorities to put in hand at the earliest possible date works which, although desirable in themselves, would undoubtedly have been postponed—perhaps indefinitely—apart from the promise of substantial financial assistance from public funds. We pointed out that had it not been for the lavish expenditure of public money in aid of works of improvement and development, there would have been little to record in our annual survey in the way of new works in home ports.

The entire outlook has been changed by the events of the past year. Grants in aid of works have been cut down wherever it has been possible to do so without doing violence to promises already made and the flow of money from the Treasury for such purposes has been checked, for the time being at any rate. This restriction of expenditure on public works is not confined to our own country. Industrial and financial conditions throughout the world have resulted everywhere in severe restriction of expenditure. In some cases works already begun but not completed have been slowed down, and there are few instances in the Dominions or in the Americas of the commencement during the year of port works of considerable magnitude.

The third and final report of the Royal Commission on Transport was issued in January. The main concern of the Commissioners was, of course, road transport and its inter-relation with the working of the railways; but inland waterways, as well as docks and harbours, came within the purview of the Commission, and a few suggestions relative to them are contained in the report. The principal recommendation concerning inland waterways is that further schemes of amalgamation of existing canal companies should be proceeded with, and that, failing voluntary schemes, the Minister of Transport should take steps to set up public trusts which would acquire such canals as he considers it would be within the national interests to preserve and improve. The Commissioners seem to have been impressed by the voluntary amalgamation, the outcome of which was the formation of the Grand Union Canal Company, and by the results flowing from it. They believe that there are some canal routes which could be made much more valuable if certain short sections were improved. The Commissioners are not in favour of the transfer of the railway owned docks and harbours to public trusts, and they deplore the state of decay into which a number of the smaller ports have been allowed to fall, this state being due in a large measure to economic factors over which individual undertakers had no control. In many cases these ports are most used by, and most useful to, coastwise shipping, and they think that attention should be given to them to prepare them for the part they will play when the present temporary depression ends.

Without exception all the works of magnitude begun this year in the ports of the United Kingdom, whether railway-owned or otherwise, including the new giant dry dock at Southampton for the Southern Railway Company, to which reference is made hereunder, are assisted by large Treasury grants.

During the year two great figures in the world of harbours and waterways passed away. Senator Luigi Luiggi, the *doyen* of Italian harbour engineers and a man well-known in this country, died in Rome in February. In March the death occurred of Lieut.-General Edgar Jadwin, formerly Chief-of-Engineers of the United States Army. During his career he was largely responsible for the great improvements of American rivers, notably the Mississippi, carried out since the beginning of the century.

The XVth International Navigation Congress assembled at Venice in September, and was attended by delegates from all parts of the world. Those present visited the port works at Venice and the neighbouring commercial port of Marghera and, in addition, had the advantage of examining the inland navigation and river regulation works in Northern Italy, as well as the great port works now being carried out at Genoa, Naples, Bari, and Palermo.

THE UNITED KINGDOM.

Port of London.

For several years past we have been able in our annual review to record either the commencement or the completion of some work of improvement of outstanding importance in the Port of London. Last year it was the passenger landing stage at Tilbury; but this year there is no such work to which it is necessary to refer.

The Port of London Authority has decided to seek powers in the next session of Parliament to acquire several private wharf undertakings in the Port of London, including that of Hay's Wharf, Ltd., whose principal riverside properties are on the south side of the Thames between London Bridge and Tower Bridge. This new development of the activities of the Port Authority will be followed with interest.

Further improvements have been carried out in the Lavender Dock, a part of the Surrey Commercial Dock system, including the building of a new quay and sheds at the north end of the dock.

The virtual completion of the main works at the new Ford factory at Dagenham towards the end of the year is an event of outstanding interest, although it has no direct connection with the activities of the Port Authority. Apart from the immense range of buildings and plant installations, which have sprung up in the course of the past two years on a riverside site which was previously nothing but marshland, the deep-water river jetty is a work of considerable interest. At this jetty the raw materials required for the works will be unloaded from ships and the finished vehicles will be loaded for export. The jetty is over 1800ft. long, and will accommodate vessels up to 12,000 tons.

In the year ending March 31st, 1931, the total net register tonnage of ships entering the Port of London was over 58 millions, an increase of more than half a million compared with the previous year. The value of imports and exports, however, shows a serious drop of more than £100,000,000 compared with 1929, when the total value was over seven hundred millions.

The Mersey and the Manchester Ship Canal.

The new dock at Birkenhead, which is being constructed by the Mersey Docks and Harbour Board, is now well advanced towards completion. The works, which were begun in May, 1930, comprise a wet dock on the Bidston Moss estate, which will form a part of the Birkenhead docks system. As a part of the Dock Board's scheme for the modernisation of cargo-handling appliances, the new radial coal conveyor at the south side of the Birkenhead West Float was brought into use during the year. This coal conveyor is intended mainly for shipping bunker coals, and the vertical range of the delivery shoot extends from 76ft. above dock water level to a point below the level of the quay. The conveyor can thus load coal into small lighters as well as into ships' bunker or cargo hatches. The radial track upon which the conveyor tower travels permits of a horizontal range of the delivery spout of 300ft.

The training bank on the east side of the Crosby Channel, begun in 1929, is still being extended seaward. The difficult problems involved in the maintenance of the sea channels of the Mersey continue to receive the anxious consideration of the Dock Board, and schemes which will involve a large additional expenditure on training banks are being examined.

The Bromborough Dock on the Cheshire side of the Mersey, for Lever Brothers, Ltd., was opened by Mr. Graham, the then President of the Board of Trade, on April 17th. Construction on the Bromborough site began in 1924 and the work of building the wet dock has been carried on in the face of considerable difficulties. The dock has been built upon 600 acres of the Bromborough port estate, 100 acres of which have been or are to be reclaimed from the foreshore. The works extend for 1¼ miles along the foreshore of the Mersey, and are about 2½ miles north of the Eastham entrance to the Manchester Ship Canal. The dock basin is rectangular in form and has a deep-water area of about 18 acres. To the north and south of it two large areas have been enclosed by retaining walls and embankments, and will be reclaimed from the Mersey. In addition, the Bromborough Pool has been canalised for a distance of about two-thirds of a mile above the dock to a point beyond the Port Sunlight wharves. This work enables barge traffic, hitherto restricted to a few hours on each tide, to be carried on uninterruptedly between the dock and the works quays. The wet dock is entered through a short lock, 75ft. wide and 165ft. long. The depth of water in the dock at M.H.W.S.T. is 35ft. At neap tides it will, of course, be considerably less. Altogether there are nearly 3000ft. of berthage in the dock and one of the quays has been equipped for oil import. The expenditure on the dock works is stated to have been over £1,000,000.

Two important works put in hand during the year by the Manchester Ship Canal Company are an additional oil dock at Stanlow and a new wharf and lay-by at Irlam. The existing basin in which petroleum spirit is dealt with at Stanlow, 4½ miles above the entrance to the canal at Eastham, is now insufficient to cope with the recent growth of this trade. Manchester is now the second most important centre in the kingdom for the importation and storage of petroleum. The new basin, like the original one constructed in 1922, is on the north side of the canal, the principal storage installations of the oil companies lying on the south side of the waterway. Oil discharged by tankers in the basins is delivered through pipes carried in a subway beneath the canal to the storage on the opposite side of it. The new basin is to be provided with a floating boom, similar to that in use at the old dock, as a fire precaution. The enlarged approach to the new dock from the canal will also serve the old dock, and will, in addition, form a turning basin for vessels using this section of the canal. The new dock is 650ft. long and 180ft. wide, with 30ft. depth of water. The Irlam wharf will be 600ft. in length, with 28ft. depth of water alongside, and it is designed to provide waterside facilities for the works of the Lancashire Steel Corporation.

North-East Coast and Humber Ports.

The new dock at Grimsby for the fish traffic of that port, the construction of which was begun towards the end of 1930 by the London and North-Eastern Railway Company, has made good progress. It is not expected that the dock will be opened to traffic before the end of 1933. At the present time a large part of the river embankment, inside of which an area of foreshore is to be reclaimed, has been completed. The embankment is formed of tipped chalk protected on the river face by concrete blocks. The wet dock itself lies at the western end of the reclaimed area and adjoins the old No. 1 Fish Dock, which, with the new dock, will ultimately form one water space, the combined area being 50 acres, of which 37 acres is provided by the new works.

The London and North-Eastern Railway Company has carried out another interesting work at Grimsby where, on the site of an old staith in the Royal Dock, a double-sided coaling jetty, 925ft. long, has been constructed. A coal-shipping plant, now being erected on the jetty, possesses some novel and interesting features. It comprises two fixed towers, each having two high-level conveyor belts, one on either side of the tower. These shipping belts will be fed by four longitudinal belts running over the jetty deck. The coal will be tipped from end-door wagons over four hoppers on separate railway tracks, situated well in-shore from the berths. The lay-out of the railway tracks provides for a straight run through of wagons over the feeding hoppers.

At the Hartlepools the railway company is making additions and alterations to the coal-shipping equipment, which, incidentally, will enable 20-ton wagons to be handled, and at Middlesbrough Dock forty-six new electric travelling cranes of from 3 tons to 10 tons capacity are being installed.

At Hull a new hydraulic coal hoist has been provided in the Humber Dock, and a scheme for the reconstruction of the fish market is about to be carried out.

The Tyne Improvement Commissioners have postponed indefinitely the scheme for the development of Jarrow Slake and the acquisition from the London and North-Eastern Railway Company of Tyne Dock, which has been under consideration by them for some years past. They have, however, placed contracts for the construction of a new coal staith on the riverside at the west end of Northumberland Dock. The staith will be equipped with belt conveyors for shipment of coal and will provide two additional berths. The substructure of the staith is estimated to cost about £90,000. The staith is to be carried on steel cylinders filled with reinforced concrete. During the year a new 40-ton Titan crane was brought into use on the North Pier at Tynemouth. It takes the place of the old block-setting crane used in the construction of the pier, which was one of the earliest of its kind employed in the building of breakwaters in this country. The reconstruction and extension of the Gateshead Corporation's quay at Gateshead-on-Tyne was completed in November. The quay now has a frontage of 700ft. and has been leased by the Corporation to the Tyne-Tees Shipping Company. The extension of the Newcastle Corporation quay at St. Lawrence, which will add 750ft. to the length of the quays controlled by the City Council, was begun in March. The new berths will have a depth of water of 30ft. at M.L.W.S.T.

The Corporation of Sunderland began early in the year the construction of the deep-water quay in the river Wear, to which reference was made in our review last year. A large part of the substructure of the quay was completed. The work is estimated to cost £350,000, and is being carried out with the assistance of grants from the Treasury. The River Wear Commissioners' new coal staith and quay in the Sunderland South Dock was brought into use early in December. In addition to the usual coaling spouts, the staith is provided with an electric belt conveyor, which is capable of delivering coal at a maximum height of 53ft. above dock-water level. The staith has been constructed to take 40-ton capacity steel hopper wagons and the berths alongside have a depth of 30ft. at dock low water.

The first stage of the Tees Commissioners' scheme for the reclamation of tidal foreshore is well advanced. The new lock at Goole, on the Yorkshire Ouse, which will afford improved access to the docks at that port, has not yet been brought into use. The Aire and Calder Navigation is still engaged on the improvement of the navigable channel of the Ouse, and work has been in progress throughout the year on the training bank at the outfall of the rivers Trent and Ouse into the Humber, the cost of which is being borne by the Humber Conservancy Board and the Aire and Calder Navigation jointly.

The Humber Bridge Bill came before a Committee of the House of Commons in May, and, after a hearing extending over thirty-two days, was passed by the Committee after some modifications had been made in the proposed plans for the construction of the bridge. The Bill was strenuously opposed by the Humber Conservancy Board, the London and North-Eastern Railway Company, which owns the Hull docks, the Aire and Calder Navigation, and many other important navigational and shipping interests. The opposition was influenced in the main by fears for the safety of the navigation in such an estuary as the Humber if obstructed by numerous bridge piers. Objection was also taken to the proposals on the

grounds that in a sandy estuary, notorious for the shifting character of the channels, the stability of the navigable channel through one span of a bridge could not be ensured. The Committee at the end of the hearing expressed the opinion that the building of training walls in the river Humber near the site of the proposed bridge is necessary if the bridge is built and should be carried on concurrently with its construction. The Parliamentary situation prevented the Bill being carried to the Lords in the autumn, but it is understood that the promoters, the Hull Corporation, propose to bring the Bill before a Lords Committee later in the present session.

Southern Railway Ports.

In any reference to the ports of the Southern Railway Company, the principal subject must naturally be the vast scheme of docks extension at Southampton, including the great dry dock, intended for the accommodation of the new Cunard liner, which the directors of the company, towards the end of 1930, decided to build instead of adopting the only other alternative, namely, that of enlarging the floating dry dock, which has been in service at Southampton since 1924. The main contract for the construction of the dry dock was placed with John Mowlem and Co., Ltd., of London, in May, and these contractors will be associated with the firm of Edmund Nuttall and Co., Ltd., of Manchester, in the carrying out of the work. The contractors had undertaken to complete the dry dock in time to receive the 73,000-ton Cunarder under construction at Clydebank, which it was hoped would reach Southampton during the autumn of 1933. Early in December the board of the Cunard Steamship Company announced their decision to suspend work on the construction of the new vessel, which was to have been launched in May next. It is understood, however, that the building of the Southampton dry dock will still continue, although, no doubt, the special measures taken to ensure its early completion will be modified. The dry dock, which will be the largest in the world, is to be 1200ft. in length and to have a clear width of 135ft. at the entrance with a depth of 45ft. over the blocks at high water of neap tides. The excavation for some part of the foundations extends to a depth of 87ft. below quay level, and over 1,000,000 cubic yards of material will have to be removed. At the present time excavation is in progress over the greater part of the area which will be occupied by the dock. The enclosing bank around the area in which the dock is being built was completed during the summer. The site of the dry dock, near Millbrook Station, is at the west end of the area reclaimed from the river Test, on which the new deep-water quays are being constructed. During the year rapid progress was made with the construction of the new quays. It is hoped to bring into use a length of 1000ft. of the first section early this year. The first of the 1000ft. long transit sheds, which are being built behind the quay walls, will be ready for use in June. The construction of the remainder of the first section of the quay, which has a total length of 3800ft., is well advanced; all the monoliths have been sunk and the area of mud-land behind the monolith wall is being rapidly filled by the deposit of material dredged from the river and pumped ashore. A beginning was made early in 1931 with the construction of the second section of the deep-water quay, 3600ft. long, and monolith sinking is in progress over a large part of its length. More than 15 million tons of spoil have been dredged from the bed of the river since the beginning of the work, and in one month an output of 500,000 cubic yards was reached. This represents about 750,000 tons. The cost of the second section of the quay walls is estimated at about £3,000,000, and that of the new dry dock at about £1,850,000.

The Southampton Harbour Board, which is responsible for the main approaches to the docks at Southampton, is faced with the problem of widening and deepening the waterway to meet the requirements of the ever-increasing dimensions of Transatlantic liners using the port of Southampton. The Board is now engaged on a five years' programme of dredging, involving an expenditure of approximately a quarter of a million pounds. The work is being carried out by the James Dredging, Towage and Transport Company, Ltd. The scheme aims at a minimum bottom width of channel of 1000ft. with a depth of not less than 35ft. at M.L.W.S.T., with 38ft. of water in certain areas near the docks. The jurisdiction of the Harbour Board does not extend below Calshot Spit, and the navigation of the outer approaches by vessels of great draught and length is a matter of some anxiety. Early in the year no less than three liners took the ground within a period of a few weeks, and Southampton shipping interests are desirous of some improvement in the natural channels in the neighbourhood of Calshot and the provision of additional lights and fog signals.

In the Isle of Wight the Southern Railway Company has completed the equipment of the new quay at Medina, Cowes, and included in the company's application to Parliament in the present session for further powers is a proposal for the construction of a small wet dock within the inner harbour at Dover. The dock will have a water area of a little over an acre and is to be constructed between the Admiralty Pier and the South Pier of the inner harbour. Work was commenced in the spring by the Dover Harbour Board on the removal of the two block ships which were sunk in the early days of the war in the western entrance of the harbour in order to prevent submarine attacks.

Bristol Channel and South Wales Ports.

The decision of the directors of the Great Western Railway Company to abandon the schemes for a new lock entrance at Swansea and the extension of the South Pier at Port Talbot for which parliamentary powers had been obtained, was announced in October. The company had about a year earlier decided to postpone the construction of these works. The railway company has, however, continued the policy of modernising the coal shipping appliances and other equipment in the South Wales ports. New dock gates are being built for the inner lock of the Roath Dock at Cardiff. The re-equipment of the south-east quay of the Queen Alexandra Dock at Cardiff with modern traversing coal hoists was continued. When this work is completed, there will be nine hoists, all of them movable, on a quay frontage 1500ft. in length and served by electrically operated wagon traversers at quay level. Five new hoists were erected on the quay during the past year. All the new coal hoists now being built for the Great Western Railway Company lift 20-ton capacity wagons. At the Roath Dock the first of five belt conveyors for the shipment of coal, which will ultimately take the place of the old shipping appliances on one side of that dock, is now being erected. It consists of a single-unit conveyor belt of the radial type and is fitted with 48in. wide two-speed belts and a "Handcock" motor-driven anti-breakage appliance.

The Great Western Railway Company has by no means abandoned the traditional preference of South Wales ports for the hydraulic hoist type of coal shipping appliance. At the beginning of the year no less than twenty-four hoists for 20-ton coal wagons were on order for Cardiff, Swansea, Newport, Barry, and Port Talbot. A large number of new electric and hydraulic cranes for general cargo were installed in the company's South Wales ports during the year. The filling in of the old entrance lock at the Prince of Wales Dock, Swansea, is another work undertaken by the railway company during the year.

(To be continued.)

The Report of the Fuel Research Board.

THE Report of the Fuel Research Board for the year ending March 31st, 1931, was issued on Monday, January 4th, and contains some interesting facts. A large part of it is devoted to various carbonisation of coal processes in which the Board is interested. That work has, perhaps, attracted greater attention than the other equally useful but less spectacular investigations that the Board has undertaken.

The Fuel Research Board, when formed in 1917, set out upon two main lines of research: firstly, to make a survey and classification of the coal seams in the various mining districts; and secondly, to investigate the practical problems which must be solved if any large proportion of the raw coal at present burned in its natural state is to be replaced by the various forms of fuel obtainable from coal by carbonisation and gasification processes. The first part of this work will take many years to complete. Its progress was much delayed by the war, and only within the last year has it been possible to arrange for the last of the local laboratories at which the examination of coal is conducted—that at Birmingham—to be fitted up and equipped. The work is now proceeding rapidly and valuable results are available to those interested. After discussing the problems encountered and the variety and nature of coal seams, progress in the different areas examined is reported. The Board considers that it is possible that when the work upon the more important seams has been completed it may be necessary to amplify the results of earlier work. In other cases extensions of the areas mined may necessitate further investigations to cover the properties of the seams now worked.

One of the principal difficulties encountered in making the survey has been that of finding a reliable and cheap method of obtaining a truly representative sample of coal for analysis. The Board co-operated with the British Engineering Standards Association—now the British Standards Institution—in bringing out a specification dealing with the sampling and analysis of coal below 3in. size. In a short discussion on sampling the Report states that, when dealing with small coal, the uniformity bears a close relationship with the ash content of the coal. The greater the ash content the greater the discrepancy between different samples of the same coal and hence the greater the number of increments and the larger the gross sample required to obtain a reliable result. For the purposes of the Board, which took in some cases large "commercial" samples of coals as produced at the collieries, two Morris lorries were equipped with Sturtevant sampling cone crushers and were used for reducing the coal obtained.

The study of the carbonisation of coal in the form of particles when it is dropped through a heated inert atmosphere was continued. When a coal of suitable size is dropped in this manner it swells and in many cases forms hollow spheres known as cenospheres. The investigations carried out on the mode of formation and structure of cenospheres has thrown light on the subjects of swelling during coking, coke formation, and the structure of coke. It is considered that the study of the swelling capacities of coals by means of cenosphere formation may form the basis of a test of the state of oxidation of weathered coals.

Before passing to the work of the Board upon the carbonisation of coal for the purpose of producing fuel oils and petrols it must be noticed that valuable results have been obtained from the experiments on the setting of horizontal gas retorts at the Fuel Research Station. The setting was designed on the usual lines adopted in standard gasworks practice to carbonise 10 tons of coal a day. It has been found possible by recirculating flue gas through the setting to increase the throughput up to 17 tons a day without increasing the maximum temperature in the combustion chamber or materially affecting the quality or the quantity of the products. Experiments are now proceeding with the object of discovering why this increase in the volume of the flue gases should have the observed effect.

At the time of the issue of the last report it was thought that such a stage had been reached in the development of low-temperature carbonisation that the priority which had up to then been given to experimental work in the development of full-size retorts was no longer justified and that work should be concentrated on investigations into the utilisation of the tars produced. The circumstances surrounding the closing down of the plant at the Richmond gasworks, however, caused the question to be reconsidered. This plant, which was designed in consultation with the Director of Fuel Research, was started up in February, 1929, but towards the end of 1930 the gas company gave notice that it did not propose to exercise its option to purchase it, as the accounts showed a considerable loss. Various difficulties, many of which, the Board considers were remediable, and of a type to be expected in the first commercial working of a new system, arose. But the most serious was the distortion of the cast iron retorts. By the end of the period during which the experiment had been conducted those retorts which had been longest in use were so misshapen as to be almost unworkable. In consequence of the partial failure of this plant work has again been concentrated on the design of the retorts and the further development of the actual carbonisation process. The Board in any case considered that the experiment at Richmond had been inconclusive. As a result of the year's work it has been found possible to increase the throughput of the retorts and reduce the running costs.

Of more importance in view of the difficulty encountered at Richmond is the development of a brick, instead of a cast iron, retort. It was found that a satisfactory smokeless fuel could be produced in such retorts at temperatures of carbonisation between 700 deg. Cent. and 800 deg. Cent., and that the tar produced was not greatly different from that obtained in cast iron retorts at 600 deg. Cent. The brick retort was completed in October, 1930, and carbonisation started in the following month. It is proposed to erect two new retorts of this type with the object of obtaining data as to their life and cost of working.

Much investigation was undertaken during the year upon the treatment of the products obtained from the retorts, such as the conversion of the tar into oil and motor spirit, but so far no generalisations can be made, as the work is not yet sufficiently far advanced. Investigations into the physical properties of pitch have been continued and interesting results obtained, while the subject of briquetting has been given attention.

During the year a small new building was erected alongside that housing the old Bergius plant for the hydrogenation of coal. There are now five 2-litre converters available for static experiments, four of which can be under heat at the same time. A considerable amount of work has been done on various processes of hydrogenation.

Some tests were carried out on a Ricardo oil engine using low-temperature spirits from various coals, and in certain cases it was found that a marked deterioration in anti-knock value had taken place after some weeks of storage. Both gas and tar spirits were subject to this effect, the gas spirits appearing to deteriorate more rapidly than the tar spirits. With tar spirits an induction period was noticed during which little or no deterioration occurred, followed by a period of rapid, although not necessarily large, drop in anti-knock value. Later, the deterioration proceeded at a slower rate. With gas spirits, the Report states, the induction period, if it occurs at all, is very short. Exclusion of air from the container greatly reduces the deterioration.

Experimental work on suction gas plant is being continued, and an investigation was made during the year of the possibility of using flax shives as a producer fuel. The conclusion finally reached was that either a preliminary treatment of the fuel was essential or that a special design of producer would be necessary, preferably working with a down draught. The Report describes some preliminary tests of the lorry producer intended for use with low-temperature coke, which gave on the whole promising, though not entirely satisfactory, results. It also contains some mention of other activities of the Board in connection with pulverised fuel firing of boilers, atmospheric pollution and other miscellanea.

SIXTY YEARS AGO.

WHILE Napoleon III. was still Emperor of the French, Monsieur Charles de Freycinet was directed by the Imperial Government to visit factories in England, France, Germany, and Belgium for the purpose of studying the means adopted for maintaining the health of people employed in unwholesome operations. There were many such operations in those days, and little was done by Government to protect the workers engaged in them. Monsieur Freycinet found that on the Continent the health of the workers was more carefully looked after than it was in England. In this country, he noted in his report, reviewed in our issue of January 12th, 1872, the manufacturers themselves in many instances held the local government in their own hands, and as a consequence there was apparently a laxity or unwillingness in enforcing such regulations as existed or in adopting voluntarily schemes for the amelioration of the workers' lot. There were, however, some noteworthy exceptions. Fans, it was noted, were used at the cutlery works of Joseph Rodgers and Sons, at Sheffield, and at the needle works of Thomas and Sons, at Redditch, for exhausting the dust produced during dry grinding processes. At some other places the draught of the factory chimney was employed for the same purpose.

At Price's candle factory at Battersea, a novel method of ventilating the storehouse for manufactured goods was observed. The roof was described as consisting of a cylinder of thin plate, and opening at the top into a number of small chimneys. The least sunshine heated the plate roof, and created a very powerful draught. At Crossfield's factory at St. Helens, the chambers wherein the chloride of lime was made were in communication through an exhaust pipe with the factory chimney. When the door was opened to gain entry into the chamber a current of air was set up, and the excess chlorine was quickly exhausted. In general, Monsieur Freycinet found that artificial ventilation was extensively relied upon to render safe operations giving rise to unwholesome vapours or dust. In certain instances, however, it was noticed that reliance was beginning to be placed, not on ventilation, but on the use of preventive modifications in the manufacturing processes. Such modifications had, for example, been introduced in the manufacture of fulminate of mercury, in the concentration of sulphuric acid, by the adoption of lead-free pastes and powders for the enamelling of iron plate, and by the use of amorphous phosphorus in place of white phosphorus in the manufacture of matches.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Anticipation.

IRON and steelmasters, engineers and manufacturers in the Midlands and Staffordshire have entered on the New Year with hope that the slight improvement in trade manifested in the closing stages of last year will not only be maintained but increased. The general opinion in industrial circles in this district this week is that there are signs of better times, and a belief is expressed that the year will see the commencement of a revival of general prosperity throughout the Midland industries. Though the weekly meeting of the iron trade in Birmingham could hardly be described as an optimistic one, there was certainly a stronger and better tone prevailing than of late, and in many quarters there was a quiet confidence displayed in the future. There was not a good deal of market activity, but this was probably due to the fact that the Quarterly Meeting takes place next week and producers and consumers alike preferred to await its revelations—if any—before committing themselves further. It is doubtful if any development of importance will occur next week to alter the present situation; indeed, none is anticipated; but it is customary to reserve business to the Quarterly Meeting when it is so near at hand.

Steel.

In the Midland steel works specifications were cleared off before the holiday, and unfortunately, in most cases, there was no great accumulation of orders during the holiday period, so that works had not much, when they resumed operations, to keep them engaged. There has been a certain amount of new business transacted this week, however, and the position at the steel works is not too bad. The continued slackness amongst constructional engineers is, however, causing a good deal of concern to steel producers in this district. Specifications for heavy material are confined to small tonnages, mainly because constructional engineers have no big contracts on hand. Steelmasters are anxiously looking for a revival in this industry during 1932, and they are also hoping that there will be more activity amongst the rolling stock concerns, which are large consumers of steel. Fortunately for some firms, there is an increasing demand for special steels. Steel works are quoting £8 a ton for steel arches used in collieries, and there has been a fairly good demand in recent weeks. Finished steel prices are unchanged, quotations being on the Association fixed basis. Local re-rollers have been taking more business of late. Most of them have work to occupy them while the new quarter's demand is developing. Orders for cold-rolled steel which used to go abroad are now helping to reinforce trade at home. While business has taken a favourable turn in some departments of the wire industry, in nails, screws and other small manufactures, the heavy side shows no forward movement. Birmingham merchants are not selling much Continental steel. Works in this district have enough material to keep them going for some little time. Continental material quotations this week were: Small bars, £5 5s. to £5 10s.; strip, £6; billets, £4 7s. 6d. to £4 10s.; sheet bars, £4 10s. to £4 12s. The scrap market remains dull and holders of material are inclined to conserve their stocks until such time as better prices are available.

Finished Iron.

In the Staffordshire iron trade the year has opened quietly, but there is no reserve of orders in any department. Finished iron is a dull market. At some of the mills making best bars the holiday was only short; but in other branches mills were idle for a full week and in some cases more. Ironmasters enter the year with hopes of a favourable development of trade, but while any general trade movement in the right direction would benefit makers of best grade bars, it needs protective measures by the Government to bring about any chance of betterment of the position in which makers of common bars to-day find themselves. They are hopelessly undercut by the foreigner, who sends iron into the bolt and nut works of the district at little more than half the price required by Staffordshire ironmasters for their product. Admittedly, the material is inferior, but in these times price—when it is so vastly different—outweighs quality. There is no change in selling rates of finished iron. Marked bars are £12 per ton, Crown iron £9 5s. to £9 15s., nut and bolt and fencing bars £8 7s. 6d., and wrought iron gas tube strip £10 10s. to £10 12s. 6d.

Raw Iron.

Midland pig iron producers take a hopeful view of the situation and anticipate a gradual extension of the improvement which has been in progress during the past two months. They hope to see a revival of demand from the heavy foundries, current buying of pig iron being, in most instances, on account of the light castings trade. No great amount of interest has been displayed this week in the raw iron market. Consumers in many instances have covered themselves for some months to come, while others are probably awaiting the Quarterly Meeting of the Midland iron trade, which takes place in Birmingham next week, before making any buying movement. Pig iron prices under the control of the Central Pig Iron Producers' Association having been reaffirmed for the time being, buyers see no need for making hasty purchases. Some naturally desire to gauge, if possible, at the Quarterly Meeting the extent of their requirements to the end of March. When they get an idea as to these they will make contracts with the blast-furnaces. There are still considerable stocks of iron in the hands of producers, and they are being liquidated but slowly. Current production is, however, about on a par with consumptive requirements, so that any accession of strength to demand would enable smelters to dispose of their stocks. Users in this area have, for the most part, no great reserve of material, and as they have only contracted for supplies known to be needed, any revival in demand for their products would soon make itself evident on the market. Pig iron business is rather unevenly divided, some furnacemen receiving good specifications, whereas others complain of a scarcity of orders. Iron this week was sold at £3 2s. 6d. for Northampton No. 3 foundry, and £3 6s. for Derbyshire, delivered at Black Country stations. Forge iron was 5s. less in each case, but there was very little inquiry for this class of material, the consumption of forge iron in South Staffordshire having fallen substantially in recent years. Furnace coke is dearer than it was three months ago, but is less stimulated by the seasonal non-industrial demand than at one time seemed likely. Smelters have no difficulty in obtaining adequate supplies at recent rates.

Galvanised Sheets.

Galvanised sheet makers have been unable to uphold the recent increased level of prices. Overseas business remains very disappointing, and orders from the home trade have during the past fortnight been very difficult to secure. Competition for the work available is very keen, and makers have shaded quotations by from half-a-crown to 5s. per ton. Local mills this week had no hesitation in accepting £9 2s. 6d. per ton for 24-gauge corrugateds, and reports are current of transactions at £9. These latter are stated to refer to good scale export business. Present selling rates are held to be unremunerative, but such is the need for orders if plant is to be kept in operation that millowners accept the business as the lesser of two evils. There are some local firms who consider £10 per ton should be regarded as the lowest level for 24-gauge if profitable production is to be maintained.

£150,000 Sewage Scheme.

The West Bromwich Town Council has before it at present proposals introduced by the Sewage Committee involving an expenditure of more than £150,000. If the proposals are approved it is intended to treat as much of the sewage in the existing low and high-level work as the beds will deal with, and to pass the remainder by means of a new outfall sewer to Ray Hall, at an estimated cost of £21,500, and construct there twelve percolating bacteria beds, and other necessary work, at an estimated cost of £76,043. This work will also treat the sewage from Newton-road outfall works, and from Barr Ward. If the proposals are carried out the total estimated capital expenditure will be approximately £119.309, in addition to £37,430 for the construction of sewers in Perry Barr. It is proposed to construct these works and sewers by direct labour, under the supervision of the Borough Surveyor.

Low-temperature Carbonisation.

The tour of various coalfields, including the Midlands, by Sir Eric Hambro, who is financing a new low-temperature carbonisation of coal process, is of interest to the Cannock district, because of the experiments which have been proceeding for the past two years in the locality. From the commencement it was realised that the Cannock experiments in connection with the Vandergrift method of low-temperature carbonisation would most probably be prolonged. Much more capital has had to be sunk in the venture than was originally contemplated, but faith in the ultimate success of the experiments has kept the concern at Leacroft in operation. Energetic efforts continue to be made to carry through the researches to a practicable and remunerative end, and new plant has recently been installed with a view to proceeding along new lines of experiment.

Russian Order for Furnaces.

The firm of Birmingham Electric Furnaces, Ltd., Tyburn-road, Erdington, has received an order for thirty-seven electric heat-treatment furnaces for export to Russia, the contract running into five figures. It is believed to be the largest single order for this type of furnace ever received in this country. The work will find employment for a considerable time for the ordinary staff, as well as for additional hands.

Rolling Stock Contract.

The Metropolitan-Cammell Carriage, Wagon and Finance Company, Ltd., of Birmingham, has received from the London, Midland and Scottish Railway Company an order for four 20-ton all-steel hopper four-wheeled wagons, specially designed for the bulk conveyance of cement, each of which will be fitted with three-roof doors for loading and also bottom discharge.

Death of Mr. Enoch Brazier.

I regret to have to record the death on Thursday last week at Newquay, Cornwall—where he had lived for some years following his retirement—of Mr. Enoch Brazier, a former director of John Thompson (Wolverhampton), Ltd. Mr. Brazier, who was in his ninetieth year, had a very long business career, and was very well known and highly respected in Midland industrial circles. An expert on tin-plating, he had been in many parts of the world, and had directed tin-plating operations in Spain and other countries. Many years ago he was associated with what was then the Manor Works of Stephen John Thompson and Co., now the ironworks of Joseph Sankey and Sons, Ltd., Ettingshall. He then joined the firm of Messrs. E. P. and W. Baldwin, Willdon Works, near Stourport before he commenced his association, which was to last for thirty years, with John Thompson, Ltd., of Ettingshall. He was a director of that concern for some thirteen years.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

The New Trafford Bridge.

PRESENT expectations are that the new bridge across the Manchester Ship Canal at Old Trafford, Manchester, which has been under construction for nearly four months, will be ready for opening to traffic early in March. On Monday of this week, one of the two main girders, 86ft. in length and 6ft. 3in. in width, was placed in position, the operation taking little more than 3 minutes. Another main girder and forty-four cross members will follow very quickly, and efforts are being made to complete the work by March 4th. The task of dismantling the old bridge which the new structure replaces was begun in August last. It may be recalled that the decision to close the bridge and divert traffic to and from the Trafford Park industrial area raised a storm of protest from the organisation representing firms in the area, and eventually a scheme was adopted which entailed very much less waste of time in the movement of traffic than would have been the case had the original proposals been put into operation.

Electrical Engineer for Stockport.

The appointment of Mr. C. H. Oldroyd, who is at present the deputy electrical engineer, to the position of electrical engineer, has been recommended by the Stockport Corporation Electricity Committee. The vacancy has arisen in consequence of the appointment of Mr. Robert Lee as electrical engineer to the Borough of St. Pancras. Something of a stir was created last month when the Stockport vacancy was advertised, the salary offered being £900 per annum, rising to £1000. The Electricity Committee decided to ignore the subsequent action of the Associated Municipal Electrical Engineers and the Electrical Power Engineers' Association in laying an embargo on applications for the position from their members, the contention of the professional bodies being that the salary scale, based on the output of the Stockport undertaking, should be £1800 per annum, less a reduction of 20 per cent. allowable for a commencing salary. The Electricity Committee adhered to the decision and maintained the advertised salary basis. The applications for the post numbered seven.

Treatment of Peat.

It is understood that a Scottish concern has decided to erect a factory in the neighbourhood of Crewe for the treatment of local deposits of peat for the production of a sound-proof material by a new process. Extensive plant has already been ordered, and the expectation is that employment will be provided locally for several hundred workpeople.

Orders for Paper-making Machinery.

An order for what is believed to be the largest cardboard-making machine of its kind in the world has been placed with Charles Walmsley and Co., Ltd., of the Atlas Works, Bury, by the Thames Board Mills, Purfleet. Messrs. Walmsley have also secured contracts recently for the manufacture of two newsprint machines.

Non-ferrous Metals.

From the point of view of actual business, the non-ferrous metals market in every section has experienced another uneventful week, the demand from consumers as well as from speculative interests being on a much-reduced scale. Under the circumstances, the fact that all the metals have lost ground to some extent will occasion little surprise. The statistical position in the case of copper is all against any material improvement in prices for the time being, unless there is a marked improvement in the rate at which it moves into consumption. The loss on balance compared with a week ago has not been severe, but it has been sufficient to indicate weakness rather than strength in this section of the market. Conditions in respect of tin are dull for the time being, and here, also, the recent tendency of prices has been downward. In this section, however, the feeling with regard to the immediate future is more hopeful than it is with copper. Lead prices at the moment of writing are under the best that have been touched during the past month, and on the whole the position regarding supplies and prospective demand is not unsatisfactory, so that a renewal of steadiness may be witnessed when trade fully recovers from the holiday influence. Spelter has been quiet, but the loss in values on the week has only been a question of a shilling or two.

Iron and Steel.

Business on the iron and steel markets locally this week has obviously not got back to normal, and transactions have been few and unimportant in almost all sections. There have been one or two orders reported for January–February deliveries of foundry iron, but apart from these the movement has been very slow. A satis-

factory feature, however, is that deliveries to Lancashire users are, in the aggregate, pretty well back to where they were in mid-December. Pig iron prices are steady, with Derbyshire, Staffordshire, and Cleveland No. 3 at 67s. per ton, delivered equal to Manchester; Northamptonshire at 65s. 6d.; Scottish at about 87s.; and West Coast hematite at 81s. Interest in manufactured iron this week has been very poor, with quotations maintained, however, at £9 15s. per ton for Lancashire Crown bars and £8 5s. for seconds. Few constructional engineering contracts of any weight have found their way to Lancashire during recent months, and virtually every firm in this branch is working at reduced capacity. Consequently, specifications for structural steel materials which rollers are securing locally are small indeed. A few orders for boiler and tank plates have been reported this week, with, however, very little business stirring in bars. Acid and basic boiler plates are quoted at about £8 15s. per ton, general plates at £8 17s. 6d., sections at £8 7s. 6d., joists at £8 15s., and large bars at £9 7s. 6d. The market for Continental iron and steel products here is decidedly dull, and despite the declared intention of foreign rollers to maintain selling prices, these are anything but strong.

BARROW-IN-FURNESS.

Hematite.

During the past few weeks stocks have been accumulating, owing to less business being done and to the fact that local requirements on steel account are of not much importance at the present time. Trade generally is dull, both on home and foreign account, and there are no signs of any improvement. Compared with trade done by other iron districts, the North-West is doing quite as well, but that is little comfort, seeing how small the tonnage is that is being dispatched from the district. There are five furnaces in blast in the area, excluding the furnace at Backbarrow, which is engaged upon a finer quality of iron. Iron ore is dull and native sorts are in limited demand, while imports of foreign ores are restricted. The steel market is very quiet. A few orders are held, but they are not sufficient to keep the rail departments engaged regularly. Shipping is very quiet.

Shipbuilding.

The P. and O. liner "Strathaird" has been completed by Vickers-Armstrongs, and was taken from her berth ready for leaving on trials. She is the second liner to be completed for the P. and O. Company, the first, the "Strathnaver," now being in the company's Australian service.

SHEFFIELD.

(From our own Correspondent.)

Year's Prospects Obscure.

IN the steel industry of Sheffield it is difficult to regard the future with any confidence or any great degree of optimism. Since the holiday break, few orders have been obtained at the big works and many of the departments are only partially employed. It is inevitable that industrialists' views on the future are tinged with doubts, for there have to be considered such factors as the uncertainty of movements of the exchanges and doubts as to the Government's intentions in regard to tariffs. But at least one important branch of the local steel industry is benefiting from the reduced value of sterling, for substantial orders are being obtained for cold rolled strips and bars. There is an increasing demand from most parts of the world for this material, which local works are well equipped to produce. In the past, however, local manufacturers have had to meet with severe foreign competition. Now the exchange rates remove much of the severity of this competition, and as a result Sheffield benefits. In a similar way, American works are finding it worth while to import Lincolnshire pig iron.

New Industries and Foreign Works.

With a view to attracting new industries to the city and dealing with inquiries for the establishment of works in the district, the Sheffield Chamber of Commerce has offered to lend to the Sheffield Corporation the services of Major T. H. Howard, the secretary of the Intelligence Department of the Chamber, for an experimental period of three months. Generally speaking, however, reports which have been published in some journals, with regard to foreign firms desirous of establishing factories here, have been exaggerated. In Sheffield, at any rate, this movement has never proceeded beyond the inquiry stage, but it is satisfactory to learn of negotiations being opened by Continental houses with Sheffield firms on the subject of taking up the manufacture of specialities under licence. At Doncaster inquiries are being made by a Continental firm which contemplates establishing a bacon factory, and is attracted by excellent transport facilities and supplies of coal and water which are available.

Mr. L. Hore-Belisha's Visit.

Mr. L. Hore-Belisha, Parliamentary Secretary to the Board of Trade, has spent three days in Sheffield investigating iron and steel trade conditions on behalf of the Government. He has visited the works of Thos. Firth and John Brown, Ltd., English Steel Corporation, Ltd., Hadfields, Ltd., Kayser, Ellison and Co., Ltd., United Steel Companies, Ltd., and Joseph Rodgers and Sons, Ltd., inspecting representative sections of local industry and meeting a representative body of men associated with industry in the city. After he had seen forging, furnace tapping, giant presses, and other aspects of steel work, he said the city provided a greater variety of processes than almost any other centre in the country. He was convinced that rationalisation resulted in the elimination of duplicated plant and led to increased efficiency and reduced costs. The scientific side of the industry was on the highest plane, and the direction and management were keen and alive. If there existed a regular demand for steels, he was sure that work would be restored and overhead charges brought down to a low economic level. At the Atlas works of Thos. Firth and John Brown, Ltd., Mr. Hore-Belisha showed special interest in a 6000-ton press which was used for the making of parts for the giant Cunard liner, on which work has been suspended at Clydebank, and also in a 20-ton electric furnace which is said to be the biggest and most modern in Europe.

Orders from Abroad.

The Belgian Minister for National Defence has placed an order with Vickers—English Steel Corporation, Ltd.—for the equipment of eight anti-aircraft posts. As a result of a recent inspection by technical experts of the Russian Government of the work of a number of British and Continental oil engine manufacturers, the firm of Ruston and Hornsby, Ltd., Lincoln, has obtained an order for about 100 vertical oil engines for the equipment of a Russian fishing fleet. In view of the recent formation of the Ruston Lister Marine Engine Company, for dealing exclusively with engines for marine work, an order of this size is particularly important. The selection by the Russians of this type of engine may be considered to be an indication of the supremacy of British engines required for marine propulsion work. The Lincoln firm are pioneers in the development of airless-injection engines, which use a heavy fuel oil and have had considerable experience in the manufacture of engines for marine work.

Hathersage Water Supply.

A water supply scheme for the Hathersage and Outseats (Derbyshire) area, which has cost £13,000, has been inaugurated. The scheme was carried through by the Bakewell Rural District Council, and the water is obtained from the Burbage Spring by arrangement with the Sheffield Corporation, the owners. The contract took just under twelve months to complete.

Doncaster Rationalisation.

As a result of the partial introduction of a rationalisation scheme at the Doncaster works of the L. and N.E. Railway Company, progress has been made in the elimination of waste time whilst rolling stock is undergoing repair. The time spent by the average piece of rolling stock in the repair shops has been reduced by two-thirds. Some 1300 locomotives and several thousands of carriages and wagons are maintained at these works, and it is thought that the saving of time will enable the company to maintain their goods services with many fewer wagons than hitherto, as a greater number of engines and wagons will be in active commission at a time.

Sheffield's Lighter Trades.

In the cutlery trade of Sheffield the most prosperous departments are those concerned with the manufacture of safety razor blades or of scissors. Since the fall in the value of the pound there has been a considerable increase in the export trade of these articles, and also in the sales in the home market where the British manufacturers are able to compete better with those from abroad. But in other departments conditions are far from good, and can be described best as "patchy." Great quantities of foreign cutlery and tools are in the country and export customers are still keeping their purchases down to the minimum.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade Outlook More Promising.

THE passing of 1931 will not be regretted by industrialists in the North of England. The year was the most disastrous in industrial history, and one continuous fight with adversity. Optimism regarding the outlook is naturally somewhat restrained, but there are many indications of better prospects for 1932; in fact, there are everywhere signs of improving trade. The steel constructional industry appears to have entered upon a period of activity, and engineers of all classes are receiving more work. A more hopeful feeling pervades the iron and steel market, and some little increase of inquiry is noticeable. Gradual trade revival is looked for, but as yet movement in that direction is extremely slow. Indication of improvement in export business is not altogether absent, though obstacles to overseas trade are still great. Stocks of pig iron will decrease with the reopening of the consuming works, and as output is insufficient to needs, production may shortly be increased by the blowing in of one or two idle blast-furnaces.

Big Orders for Coal.

One of the most encouraging New Year features is the improvement in the North-East coal trade. Lost markets are being recaptured, and new avenues of trade opened out. It is felt that 1932 will restore full confidence to the Northumberland and Durham coalfields. An order received from Turkey for a cargo of 4000 tons of bunker coal this week has aroused considerable interest. Turkey has not been a customer for North Country coal for a long time, its own resources having been developed to such an extent in the past few years that British coal was no longer required, and Turkish coal was being exported in considerable quantities to other Eastern Mediterranean countries. Turkish coal consumers now, however, seem to find it advantageous to take British coal again under the reduced exchange value of the pound. Cargoes of bunker coal have also been shipped to the West Indies, which formerly took supplies from the United States. The United States itself is taking a large quantity of coke nuts, which is shortly to be shipped from the Tyne. The changed conditions have also stemmed the falling off in demand from Scandinavia, and an order for 20,000 tons of Northumberland bunker coal has been received from Murmansk, in North Russia, to be dispatched during the next three months for the fuelling of trawlers and ice-breakers. Two further orders of 8000 tons, each of best Northumberland steam coal, are to be shipped to the North of Italy this month, and they follow upon a previous order for 8000 tons for the same destination. The various coal staithes already show increased animation, and several collieries that had been lying idle have recently been recommissioned.

Cleveland Iron Trade.

Conditions show a slight improvement in the Cleveland pig iron trade. Inquiries circulating on home account are, in one or two cases, for delivery over the whole of the year, and hope is expressed that a few rather substantial forward contracts may be arranged. Generally, however, buyers are confining their purchases to small quantities for immediate requirements. Merchants report occasional Continental inquiries for Cleveland iron. They are not at liberty, however, to sell Cleveland iron to principal home consumers, makers reserving to themselves the right to cover such needs. Prices are steady and firm, No. 1 Cleveland foundry iron being 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

Hematite Pig Iron.

Merchants have fairly large holdings of East Coast hematite pig iron, and these are being pressed on the market. Supplies are abundant, stocks having increased over the holidays, and plans for increasing the output are in abeyance. Prices are unsteady, mixed numbers ranging from 65s. to 66s.

Iron-making Materials.

Conditions do not permit of transactions in the foreign ore trade. Consumers are heavily bought and, with rates of exchange uncertain, sellers are not disposed to fix prices. The coke market is distinctly firmer. Export business is brisk, and the quotation for good medium blast-furnace qualities is up to 17s., delivered to the works.

Manufactured Iron and Steel.

The manufactured iron and steel trade shows little change. Substantial contracts for constructional steel will keep producers busy for some time, but in nearly all other departments plant is only moderately employed. Prices are unchanged. A £20,000 order for railway accessories for the Siamese State Railways has been secured in face of keen foreign competition by Thomas Summerson and Sons, Ltd., of Darlington.

Iron and Steel Exports.

Exports of iron and steel from the Cleveland district in December showed a considerable contraction compared with the November returns. An aggregate of 49,919 tons of pig iron, manufactured iron and steel were shipped in November, but during December the total amounted to only 37,327 tons, a reduction of 12,592 tons. Of the 11,634 tons of pig iron exported, 5844 tons went coastwise and 5790 tons to foreign countries. Of the aggregate of 24,927 tons of steel, 14,821 tons were shipped to the Colonies and foreign countries, and 10,106 tons sent coastwise.

The Coal Trade.

Recent bookings have absorbed the bulk of the anticipated output of coal in the North of England for this month, and holders of additional lots are not forcing the market. Prospects all round are good, and firm values are indicated. Northumberland large coals of every class are winning back trade in Scandinavia. Polish coal has been and still is a formidable rival in that region, but the changed currencies have given Northumberland producers a fresh opportunity, and the most is being made of it. Prices are now about the same as for Polish coal, but importers in the Baltic constantly point out that the business now being regained can be held only if the price is right. Best Northumberland steams are firm at 13s. 9d. to 14s., as are Tyne prime for prompt, being sparingly offered at 13s. 3d. forward. Wear prime large are well booked for prompt and offered in moderate volume at 15s. Best small steams are in request and steady at 8s. 6d. Durham gas coal is steady for prompt, but mild weather in home centres is limiting spot shipments. Best qualities are quoted at from 14s. 6d. to 14s. 9d., and seconds at 13s. 6d. Bunker coal is in well-sustained demand, and fitters for all the favourite grades report being booked for the whole of this month, with a fairly large number of offers under negotiations. Prices consequently remain firm at 14s. 3d. to 14s. 9d. Secondary bunkers are in good supply, but steady at 13s. 3d. Coking unscreened moves slowly at 13s. to 13s. 9d. New inquiry for the various coke grades is on the slow side, but makers are all well sold for this month's production, and with the good market tone are quoting firmly for all forward deliveries. Best gas coke remains at 19s., patent oven coke 17s. to 17s. 6d., and superior makes 18s. to 21s.

SCOTLAND.

(From our own Correspondent.)

Holiday Influences.

MARKETS, as a rule, are still affected by holiday influences, and at least another week must elapse before conditions become normal. Many steel and iron works either remain closed or have only partially restarted, and the output of coal has not resumed normal proportions.

Steel.

Makers of heavy steel have been quiet for a considerable period, and it cannot be said that prospects are much improved. Sheet makers, on the other hand, report improvement. Inquiries have increased and the actual volume of business has shown a welcome expansion. Prices obtainable for export have not been satisfactory, however, as those makers depending on Continental sheet bars and slabs have found their costs increased by almost

20s. per ton, and it would appear as though an advance in sheet prices cannot be long delayed. Tube makers have been very indifferently employed for some time, but an improvement is hoped for, especially as the probable merging of the chief interests in Scotland may soon be an accomplished fact.

Iron.

Bar iron makers are hopeful that the reduction of 10s. per ton in the basic price may influence business. For a long period the flow of orders has been most disappointing. Up to the present re-rolled steel bar producers have not been able to secure a price sufficient to compensate them for the increase in the price of Continental billets. Meantime, re-rolled steel bars are quoted £6 5s. home and £6 2s. 6d. per ton export.

Pig Iron.

The number of furnaces in blast in Scotland remains at five. There is no indication of any early increase in demand and the output is ample.

Scrap.

Cast iron machinery scrap maintains a firm attitude at 57s. 6d. to 60s. per ton, but heavy steel is a shade easier at 40s. per ton.

Coal.

The coal market still preserves a holiday appearance. Outputs are not yet up to normal, and practically nothing fresh in the way of export business is reported. East of Scotland collieries are comparatively well sold for January loading, but West of Scotland fuels are not quite so well situated. The general inquiry is meagre, and prospects of improved export demands are not particularly good. Prompt or early shipments alone are mentioned. Home sales are restricted by mild weather conditions and the industrial depression, requirements being far below normal.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The Coal Trade.

THE New Year has not opened with the conditions in the coal industry showing any improvement upon those in evidence at the close of 1931. It is true that business has been more or less dislocated by holidays, but it is unfortunately a fact that since then there has been no perceptible expansion in the inquiry. Quotations have been asked for an occasional cargo, but there has not been an accumulation of orders such as to put any new life into the market. At the same time, despite the depressing conditions prevailing, the New Year has been started upon with hopes and a belief in some quarters that a definite improvement will be seen during the next twelve months. Where it is to come from is, perhaps, a very difficult question to answer, but if any reliability can be placed on trade cycles, then it is argued that an expansion in trade is due. Last week was not a good one for the bulk of steam coal collieries, the average of vacant loading berths being much too high. At the end of the week the total came to thirty-five, and on Monday, instead of the position in this respect being better, it was actually worse, as the number rose to thirty-eight. This was not altogether unexpected in view of the bad weather, and the fact that chartering operations for prompt tonnage were restricted. According to the returns available the total amount of tonnage chartered last week was only slightly over 140,000, which is well below the average, and certainly much less than what is required to keep the collieries well employed. At the same time, the figures relating to shipments last week turned out better than could have been expected in view of the comparative inactivity prevailing. According to the returns of the Great Western Railway Company, the total for the six ports in which it is interested came to no less than 397,390 tons, which compared with 338,965 tons for the preceding week, which was Christmas week. For once in a way the total for last week exceeded the quantity for the corresponding period of twelve months ago, when the total was 379,059 tons, but it should be pointed out that a year ago this district was troubled with a strike on the part of the miners. Not only has current business in coals been without special feature, but there has been no development in contract operations. The only news which has come to hand is that following on the order for 90,000 metric tons of locomotive coals on a c.i.f. basis for the Egyptian State Railways, the same buyers have confirmed the purchase of 30,000 tons of Welsh coal on a f.o.b. basis. When tenders were originally sent in, prices for supplies on a f.o.b. basis were 17s. 7d. and 17s. 9d., but it is reported that the price agreed for the 30,000 tons just concluded is 18s., and it is therefore assumed that this is for a special coal.

Control of Coal-trimming.

Reference was recently made to the agitation for a revision of the existing system of coal-trimming as the result of a complaint that South Wales compared very unfavourably with the Tyne in the matter of despatch afforded to steamers bunkering. Since then the agitation has subsided to some extent, and this may be due to the expression of opinion by Mr. Dan Radcliffe, who is himself one of the leading Cardiff shipowners and is chairman of the Employers' Panel of the South Wales Area Trimming Board and the Cardiff Employers Clearing House. A statement issued by him points out that it should be well known that negotiations are going on between the South Wales Coal Shipment Advisory Committee, representative of all employing interests, and the Employers' Panel of the South Wales Area Trimming Board, which is the organisation of the Shipping Federation to deal with local trimming matters, and that it is imprudent at this stage to enter into a controversy while the matters are under review by the competent authorities. The subject came up for consideration by the South Wales Coal Shipments Advisory Committee at Cardiff on Monday, and arrangements were made for the whole question to receive further immediate consideration.

Cardiff an Air Port.

Cardiff received a check to its ambitions to become an air port not so long ago, as the Air Ministry licence was not forthcoming, owing to the Splott aerodrome not being considered sufficiently safe for landing. The sum of £18,000 has already been spent on the drainage and lay-out, and further expenditure bringing the total to £23,000 is required to equip the aerodrome fully. The Finance Committee of the Cardiff Corporation on Monday authorised the immediate expenditure of £250 in order to put in order the small portion of the ground which is soft. When that is done hopes are entertained that the Air Ministry will grant the temporary licence to allow the ground to be used in the immediate future. The position was made clearer to the Finance Committee by the City Engineer, who explained that the completion of the work could not be properly undertaken until the return of favourable weather. The whole of the trouble had been due to the work being done in bad weather in order to provide some relief for unemployment and in an endeavour to use the ground too soon. It was his intention to postpone the work for at least three months with the exception of the expenditure of £250, which he hoped would be sufficient to meet the conditions required for a temporary licence.

Iron and Steel.

During the past week or so the outlook in the tin-plate and galvanised sheet trades especially has displayed improvement, and although the prospects do not point to full time being worked by any means, it is estimated that during the first quarter employment will be more regular. It is reported that a few substantial orders have lately been received and others are looked for. It is stated that the Shell Oil Company has placed an order for 800,000 boxes of oil-size plates valued at approximately £600,000. This order is for delivery over the whole of the year, and has been spread among works throughout South Wales. Other orders for plates for food canning have also been received, and Canadian orders have also come to hand because of the Canadian tariff raised against American products. Four mills at the Clyne Tinplate Works restarted on Monday after being closed down since September, 1930, owing to the depression, and the Briton Ferry Steel Company, which owns the works, hopes to have the remaining mills operating in a few weeks. Two additional mills at the Old Castle Tinplate Works, Llanelly, resumed on Monday, and operations were expected to be resumed at the Elba Tinplate Works, Crymlyn Burrows, Swansea, on Wednesday of this week, after being suspended since July last. A South Wales firm of brewers recently placed an order for the supply of steel flagon casks to be used instead of wooden ones, and if the experiment is successful repeat orders will, it is expected, follow. A petition signed by nearly 1000 men formerly employed at the Brymbo Steel Works, near Wrexham, has been sent to the Board of Trade urging that some protective measures should be adopted to enable the works to reopen. On Thursday of last week imports into South Wales included 7522 tons of Belgian iron and steel, which went to Newport.

Current Business.

The market from day to day has been devoid of any note. The demand generally has been very quiet and prices have, for the most part, been on the basis of minimum prices for steam coals. Dry qualities have formed the steadiest section, as has been the case for some time past, while small coals have been relatively in least demand. Coke has proved a steady section, but patent fuel has not met with any improved inquiry. Pitwood remains about 24s. to 24s. 6d. for Portuguese wood, and 25s. 6d. for French wood. Imports of pitwood have been much reduced for some months past, but more especially during the last fortnight. The quantity last week amounted to 11,160 loads. Supplies from France were much reduced, especially since Great Britain went off the gold standard. This has very materially affected the French trade, the fact of the devaluation of the pound making a difference to the French exporter of approximately 5s. per ton. The result is that imports of Portuguese pitwood have expanded, and it is noticeable that last week's imports of pitwood comprised 6900 loads from Portugal, whereas the quantity from France was 4260 loads.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. J. M. JOHNSTON, North of England manager for the Stirling Boiler Company, Ltd., with offices at 17, St. Ann's-square, Manchester, retired on superannuation at the end of last year.

BERNARD HOLLAND AND CO., of 17, Victoria-street, Westminster, S.W. 1, ask us to announce that they have taken up the sole selling rights of the Darlington Rustless Iron and Steel Company, Ltd., of Darlington.

DANIEL ADAMSON AND CO., Ltd., of Dukinfield, have acquired the goodwill, all patterns and drawings, the property of Tinkers Ltd., boilermakers, of Hyde. Messrs. Adamson and Co. have also recently laid down new plant and equipped a new bay for giving service to undertakings needing all kinds of high-class riveted and welded work.

BABCOCK AND WILCOX, Ltd., the head offices of which are at Babcock House, Farringdon-street, London, E.C. 4, ask us to announce that their contract drawing offices, which have hitherto been housed in the London office, have been transferred to their Renfrew Works. The Designing Department will, however, still remain in London.

BURTON, GRIFFITHS AND CO., Ltd., of Montgomery-street, Sparkbrook, Birmingham, ask us to announce that they are now acting as sole selling agents for the line of automatic lathes produced by Messrs. Potter and Johnson, of Pawtucket, R.I., U.S.A., and that its associated company, B.S.A. Tools, Ltd., has been granted a manufacturing licence by Messrs. Potter and Johnson.

CATALOGUES.

NATIONAL GAS ENGINE COMPANY, Ltd. Ashton-under-Lyne.—Publication No. 901A of vertical oil engines from 16½ B.H.P. to 165 B.H.P.

JOHNS-MANVILLE COMPANY, Ltd., 46, Victoria-street, S.W. 1.—New brochure on insulating materials of all kinds and for all temperatures.

BRITISH PISTON RING COMPANY, Ltd., Holbrook-lane, Coventry.—A booklet describing the firm's progress during the past twenty years.

CARBORUNDUM COMPANY, Ltd., Trafford Park, Manchester.—"Recommendations on the Selection and Application of Grinding Wheels."

COVENTRY VICTOR MOTOR COMPANY, Ltd., Coventry.—Leaflets on vibrationless engines for land, sea and air, and particulars of a light delivery van.

DOBBIE MCINNES AND CLYDE, Ltd., 57, Bothwell-street, Glasgow.—A leaflet on the "Teldep" ships' draught and displacement indicator.

JOHN I. THORNYCROFT AND CO., Ltd., Thornycroft House, Smith-square, S.W. 1.—Price lists and data sheets of freight chassis and body work.

HATHORN, DAVEY AND CO., Ltd., Leeds.—Publication 831 on "Helivane" and "Contrawhirl" pumps for raising large volumes against low head.

JOHN LE BOUTILLIER, Ltd., 13, Rood-lane, London, E.C. 3.—A catalogue of high capacity cranes made by Maschinenfabrik Augsburg-Nuernberg A.G.

LAUNCHES AND TRIAL TRIPS.

MANVANTARA, motor tank ship; built by Netherland Shipbuilding Company, to the order of Royal Shell Company; dimensions, 467ft. by 61ft. 9in. by 34ft.; to carry oil in bulk. Oil engines constructed by Werkspoor Company; trial trip, Tuesday, December 15th.

CONUS, twin-screw motor oil tank vessel; built by Workman, Clark (1928), Ltd., to the order of Anglo-Saxon Petroleum Company, Ltd.; dimensions, 465ft. by 62ft. by 34ft.; to carry oil in bulk. Oil engines of Werkspoor type; trial trip, December 22nd.

COURLAND, single-screw steamer; built by Barclay, Curle and Co., Ltd., to the order of Leith, Hull and Hamburg Steam Packet Company, Ltd.; dimensions, 250ft. by 38ft. by 24ft. 9in.; to carry cargo and passengers. Engines, triple-expansion; constructed by North British Engine Works of the builders; launch, December 24th.

CALENDARS, DIARIES, &c.

BEECHCROFT AND PARTNERS, Ltd., Mappin-street, St. Peter's Close, Sheffield.—Wall calendar with monthly tear-off sheets.

BOULTON AND PAUL, Ltd., Norwich.—Wall calendar with monthly tear-off sheets.

BURTON, GRIFFITHS AND CO., Ltd., Montgomery-street, Birmingham.—Wall calendar with monthly tear-off sheets.

CAMBRIAN WAGON COMPANY, Ltd., Cardiff.—Calendar with daily tear-off sheets.

FEED WATER SPECIALISTS COMPANY, Liverpool.—Diary.

LIVERPOOL ELECTRIC CABLE COMPANY, Ltd., Linacre-lane, Booth, Liverpool.—Wall calendar with monthly tear-off sheets.

MACHINERY AND TECHNICAL TRANSPORT, Ltd., Ling House, South-street, Finsbury-pavement, E.C. 2.—Wall calendar with monthly tear-off sheets.

POPE'S ELECTRIC LAMP COMPANY, Ltd., 5, Arthur-street, New Oxford-street, W.C. 1.—Wall calendar with monthly tear-off sheets.

SUBMARINE SIGNAL COMPANY, 9, Victoria-street, S.W. 1.—Wall calendar with monthly tear-off sheets.

TRAVEL ASSOCIATION OF GREAT BRITAIN AND IRELAND, Kinnaird House, 1, Pall Mall East, S.W. 1.—Diary of events, 1932.

UNITED STEEL COMPANIES, Ltd., Sheffield.—Desk diary.

WELIN-MACLACHLAN DAVITS, Ltd., London.—Refill for desk stand.

CONTRACTS.

VICKERS-ARMSTRONGS, Ltd., have received from His Highness the Nawab of Bahawalpur an order for Carden-Loyd tractor trucks.

RUSTON AND HORNSBY, Ltd., of Lincoln, have received from the Russian Government an order for about 100 vertical heavy-oil engines for the equipment of fishing vessels. This order was given in spite of severe competition from the Continent.

BLACKSTONE AND CO., Ltd., of Stamford, have received an order for the supply and erection of the whole of the machinery required for pumping crude sewage and storm water at the Sneinton pumping station of the City of Nottingham. The contract provides for the supply of four 8in. and two 12in. "Unchokeable" crude sewage pumps, together with a 3in. general purpose pump. The pumps are to be electrically-driven by vertical slip-ring motors and controlled by float-operated automatic switchgear.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., Rugby, has received an order from the London, Midland and Scottish Railway Company for six 1500 kW rotary converters, with starting panels and transformers. These machines, which are required in connection with the increased traffic on the Euston to Watford line, will each be rated at 1500 kW, 630 volts, 25 cycles, 500 r.p.m. The same firm has also received an order for the reconstruction of three rotary converters at Cheapside sub-station at Birmingham, with alterations to the existing E.H.T. switchgear and automatic control gear, and the modification of three rotary converters and transformers at Court-road sub-station in that city.

IRON AND STEEL INSTITUTE.—The Council of the Iron and Steel Institute regrets to announce that owing to the prevailing conditions, particularly the unfavourable rate of exchange, it has been decided to postpone the meeting which, by kind invitation of the American Iron and Steel Institute and the American Institute of Mining and Metallurgical Engineers, was to have been held in the United States in September, 1932. The alternative arrangements to be made for the autumn meeting this year will be announced as soon as possible.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	17/- to 20/6
(1) Spanish	17/- to 19/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	16/6 to 17/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 5 0	3 5 0
No. 1	3 5 6	3 5 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(s) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(s) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(s) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST— N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (a) / 4 0 6 (b) / 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0	7 10 0
Sheets (Gal. Cor. 24 B.G.)	10 12 6	9 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 15 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 15 0 to 8 0 0	—
Small Re-rolled Bars	6 17 6 to 7 0 0	—
Billets and Sheet Bars	5 7 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 0 0 to 9 2 6	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	14/3 to 14/9
Block Tin (cash)	136 17 6
„ (three months)	139 17 6
Copper (cash)	37 18 9
„ (three months)	38 7 6
Spanish Lead (cash)	15 2 6
„ „ (three months)	15 3 9
Spelter (cash)	14 6 3
„ (three months)	14 15 0
MANCHESTER—	
Copper, Best Selected Ingots	41 10 0
„ Electrolytic	48 0 0
„ Strong Sheets	77 0 0
„ Tubes (Basis Price), lb.	0 0 11
Brass Tubes (Basis Price), lb.	0 0 10
„ Condenser, lb.	0 1 0½
Lead, English	16 15 0
„ Foreign	15 7 6
Spelter	14 12 6
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

Tungsten Metal Powder	2/4 per lb.
Ferro Tungsten	2/- per lb.

	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 12 6	7/-
„ „ 6 p.c. to 8 p.c.	£23 10 0	7/-
„ „ 8 p.c. to 10 p.c.	£22 10 0	6/6
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£36 0 0	10/-
„ „ „ 1 p.c. carbon	£40 0 0	12/-
„ „ „ 0·70 p.c. carbon	£51 0 0	13/-
„ „ carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£9 10 0 scale 5/- per unit	
„ „ 75 p.c.	£15 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/9
„ „ Ell	14/6
„ „ Splint	14/3 to 15/9
„ „ Trebles	16/-
„ „ Doubles	13/6
„ „ Singles	10/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	17/-
„ „ Trebles	16/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/-
Screened Navigation	17/-
Trebles	16/6 to 17/-
Doubles	13/6 to 14/6
Singles	11/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/6 to 12/9
Secondary Steam	12/3
Trebles	16/- to 16/6
Doubles	13/6
Singles	11/-

(8) N.W. COAST— ENGLAND.

Steams	21/-
Household	32/6 to 51/8
Coke	20/- to 21/-
NORTHUMBERLAND—	
Best Steams	13/9 to 14/-
Second Steams	12/- to 12/6
Steam Smalls	8/6 to 9/-
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6 to 14/9
Second	13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD—	Inland.	Export.
Best Hand-picked Branch	26/- to 27/-	—
South Yorkshire Best	24/- to 25/-	—
Derbyshire Best Bright House	20/6 to 21/6	—
Best House Coal	22/- to 23/-	—
Screened House Coal	19/- to 20/6	—
Best Screened Nuts	17/- to 18/-	—
Small Screened Nuts	15/6 to 16/6	—
Yorkshire Hards	17/- to 18/6	—
Derbyshire Hards	17/- to 18/6	—
Rough Slacks	9/- to 10/-	—
Nutty Slacks	7/6 to 8/6	—
Smalls	5/6 to 6/6	—
Blast furnace Coke (Inland)	11/- to 12/6 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b., 17/- to 18/-		

CARDIFF— (9) SOUTH WALES.

Steam Coals:	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	19/- to 27/6
No. 3 Rhondda Large	19/9 to 20/-
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	19/- to 19/6
Pitwood (ex ship)	24/- to 25/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/- to 48/6
Beans	28/6 to 32/6
Peas	20/- to 22/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/3 to 8/9
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate: Joists (minimum), 22/6: Ordinary Ship, Bridge, and Tank Plates and Sections. 15/- if home consumers confine purchases from associated British Steel Makers. Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

National Works.

THE national programme of public works, for which Parliament has just voted a sum of 3476 million francs, was not primarily intended for the relief of unemployment. Its object was to complete works that had to be suspended as the result of the reduction and gradual suppression of German reparations in kind. The character of the programme changed when this country was drawn into the vortex of the world trade depression, against which it was able to hold out until quite recently for the reasons, first, that the national well-being is based upon a highly protected and developed agricultural industry, and, secondly, that the manufacturing, mining, and some other industries have been extended with the aid of foreign labour that began to leave the country with the first signs of depression, and it was only when the slowing down of activity affected French labour that the crisis became acute. This coincided with the closing of foreign markets and the collapse of certain essentially French industries that depended almost entirely on an export business. Unemployment has, therefore, increased rapidly, and will only be partially relieved by the new programme which allocates 1165 million francs to the Minister of Public Works, 25 millions to the merchant marine, 95 millions to the Navy, and 177 millions for civil and military air equipment. Some of the municipalities are putting in hand important works. Paris is starting upon undertakings that would otherwise have been delayed. The sewage works at Clichy are to be extended. At present they deal with 1,100,000 cubic metres of used water and sludge a day. The quantity sent to the farms at Achères varies from 200,000 to 900,000 cubic metres, according to the season and the weather, and after decantation of the remainder, the water is discharged into the Seine below Paris. The new pumping station will have an oil engine plant. The capacity of the works at Colombes will also be increased. Many miles of water mains will be laid down in Paris. The railway companies have been authorised to raise money so that they may be able to distribute orders for rolling stock amongst builders who are now almost entirely without work, and the Minister of the Colonies has asked the Colonial Governments to order immediately the railway and other material they require. There is, in fact, a vigorous attempt to create an atmosphere of activity, and in all cases French material will be employed, while an effort is made to overcome the general reluctance to spend money by distributing bills all over the country exhorting the public to regard it as a national duty to "buy and avoid unemployment." All this will no doubt help business, but there is no organisation for future trade development, or any idea of how it can be done, except by commercial arrangements to facilitate foreign trade.

Paris Water Supply.

The Paris Municipal Council will shortly begin the preliminary works for bringing water from the Vals de Loire. In a report upon these works presented to the Council it is stated that the idea of utilising the water in the Loire valley dates back to the time of Louis XIV., and was later taken up again by Baron Houssmann. The present scheme was presented to the Municipal Council twenty years ago, and it was only in 1927 that an inquiry began to be made into the ways and means of carrying it out. At that time all the Departments through which the mains would pass were favourable to the proposal, except the Loiret, and the amounts of indemnities were fixed to cover the expenses that would be incurred by the Departments. Since then local opposition to the scheme has grown, but that did not prevent the Government from authorising the Paris Municipal Council to put it into execution. The water underlying the sandy bed of the Loire valley will be pumped from wells and sent to Paris, mainly by gravity, for a distance of about 90 miles. A barrage will be constructed at Villarest for the storage of water, which will be returned to the river Loire in times of drought. The cost of carrying out the scheme is estimated at 2000 million francs. It is believed that it will solve the problem of the Paris water supply for practically all time.

Seine Navigation.

The port of Rouen stands at the head of French ports in point of tonnage, and its situation gives to it special advantages for distribution, which makes it the outpost of the port of Paris, while along the Seine there have grown up of late years important oil, paper, chemical, and other industries that depend upon seaborne traffic for raw material. Below Rouen, serious impediments to navigation, in the form of shifting sand bars at the mouth of the Seine, which allow of only 6 m. to 7·5 m. of water, at times, are encountered, and these shifting sands sometimes prevent the passage of seagoing boats altogether. As the tonnage of cargo boats is increasing, Rouen is threatened with a loss of traffic through the necessity of boats unloading at Havre. Plans have, therefore, been approved by Parliament for keeping an open channel at the mouth of the Seine by the construction of dykes which will increase the depth of water at low tide to 8 m. and to 9·5 m. at high tide. It is claimed that these dykes will save Honfleur from an inevitable silting up of the port, and will also benefit seaside resorts along the Calvados coast.

Sales Comptoirs.

One method of trade organisation which has been carried out successfully in some cases, but usually fails in times like the present, when everyone is wanting business, is the centralising of sales, and producers of merchant bars have just formed a comptoir for the distribution of orders amongst its members and the fixing of prices. It is found, however, that this comptoir is not feasible unless it is associated with the allied comptoirs for joists and partly manufactured steel, which are being reorganised, and as all the merchant bar producers have accepted in principle this association, there will have to be a readjustment of quotas in the other comptoirs, which, it is feared, will offer great difficulties, and there is some doubt whether the negotiations will be carried through at an early date.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

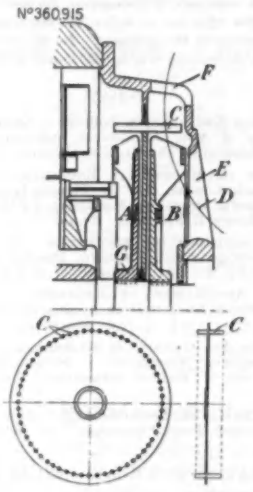
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

360,915. August 8th, 1930.—DYNAMO ELECTRIC MACHINES, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C 2, and Walter Muir Cranston, of the General Electric Company, Ltd., Witton, Birmingham.

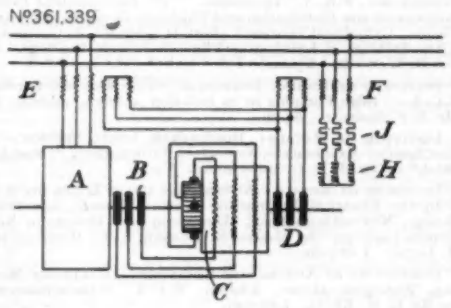
Enclosed electrical machines constructed in accordance with this invention have two fans, A and B. The fan A causes the enclosed air to circulate past the commutator hub through the armature, past the bars C and back through the armature coils,



and additional circulation is caused by radial vents in the armature. The fan B causes external air to flow in the direction of the arrow D, through the apertures E in the end shield, past the bars C and out through apertures F in the end shield. Heat is thus extracted from the internal air by means of the bars C, from which heat is extracted by the external air flow. Furthermore, heat flows from the fan A through the hubs and shaft to the fan B by which it is dissipated to the external air.—*November 9th*, 1931.

361,339. July 8th, 1930.—CASCADE-CONNECTED ELECTRICAL GROUPS, *International General Electric Company, Inc., of 120, Broadway, New York, U.S.A.*

In the case of certain alternating-current drives, as, for example, trains of rollers and motor generators, it is desirable, either entirely or within a certain range of loading, to attain a a very strong compounding. The known methods of providing this compounding lead either to very complicated connections and machines, or involve considerable losses in working, and the object of this invention is to overcome these disadvantages. In the diagram, A is the asynchronous machine to be compounded; B are the slip rings of a rotor-energised compensated commutator machine C, which is mechanically coupled to the

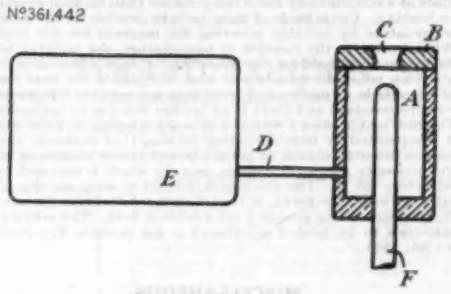


machine A. The excitation current is fed to the slip rings D of the machine C from the two secondary windings of current transformers E and F. The primary winding of the transformer E is in series with the primary winding of the asynchronous machine A. The primary winding of the transformer F is connected in series with an ohmic, inductive or capacitative resistance, or with any suitable combination of such resistances, indicated by J and H. These resistances can also be constituted by a dynamo-electric machine. The no-load speed of the cascade set can be adjusted by alterations of the ohmic resistance J, and the power factor by alteration of the inductive resistance H. Other regulation is possible if the current transformers are provided with tappings or are constructed as induction regulators.—*November 9th*, 1931.

SWITCHGEAR.

361,442. August 27th, 1930.—ELECTRIC SWITCHES WITH VAPOUR ARC-QUENCHING CHAMBERS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The switch described in this specification is worked with vapour, for example, water vapour, so as to secure extinction of the arc by the expansion of the escaping vapour, the expansion persisting substantially beyond a passage of the current through zero. The switch chamber A is closed at the top by a cover B serving as a contact. A movable contact pin F is pushed into the orifice C in the contact B, thereby closing the orifice in a vapour-tight manner, and completing the circuit. The switch chamber A is connected with the vapour boiler E by a pipe D, the cross section of which is very small relatively to the cross section of the orifice C. On switching off, the contact pin F is disengaged from the orifice C in the cover B. The vapour in the chamber A is discharged through the orifice C and, by expansion and condensation, extinguishes the arc which is struck between the contacts B and F. The switch chamber A is again filled with vapour through the pipe D, when

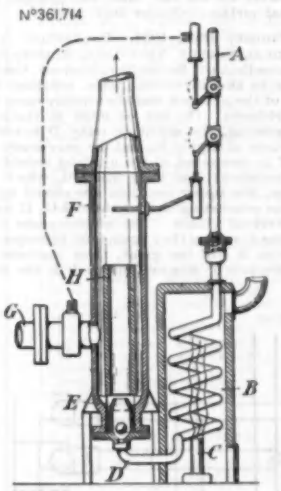


the contact pin F again closes the orifice C. The vapour continues to flow until the pressure in the chamber A has become equal to the pressure in the vapour boiler E.—*November 26th*, 1931.

GAS PRODUCERS.

361,714. January 24th, 1931.—APPARATUS FOR THE TREATMENT OF FUEL BY DESTRUCTIVE HYDROGENATION, G. Zotos, 30, Dernburgstrasse, Berlin-Charlottenburg, Germany.

The object of the invention is to obtain a highly effective internal heating in apparatus for the treatment of fuel by destructive hydrogenation. It is, says the inventor, essential in such processes, which are usually carried out under high pressure in the presence of combustible gases or gas mixtures, to maintain definite temperature drops, in order to obtain a high yield and obviate technical working difficulties. The process is of special importance in the cracking of heavy petroleum oil where local overheating sets up a great deal of trouble. According to the invention, the heating gas, which is brought into direct contact with the substance to be heated and which is mostly maintained under pressure, is mixed continuously with preheated air or oxygen. In this manner an instantaneous ignition and combustion of gas will take place, and the desired temperature will be obtained by the mixing of the products of the combustion with the remaining heating gases. The air or oxygen must be preheated at least to the ignition tempera-

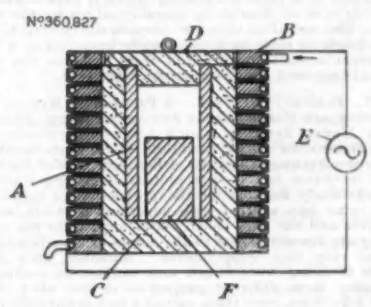


ture of the gas in order to bring about a uniform combustion. The regulation of the temperature is effected by admitting more or less air or oxygen into the gas current, and that can be done automatically by means of a thermostat placed under the influence of the gases. Air, which is maintained at a higher pressure than that used in the decomposition process, is fed from a pipe A through a preheating chamber B wherein it is heated by means of a burner C to a temperature exceeding the ignition temperature of the gas to be used in the decomposition process. The heated air passes continuously through a pipe D and a burner E into a pressure combustion chamber F, which, at the same time, receives, from a pipe G, a continuous flow of combustible gas. Combustion of the gas takes place as soon as it enters the chamber, and the products of combustion mix with the unconsumed heating gases. The combustion preferably takes place within a protecting sleeve H, which prevents the flames from coming into direct contact with the walls of the chamber F. The heated gas mixture thus produced passes out at the top of the chamber into the apparatus, wherein the cracking process takes place. Various safety devices are included in the arrangement of the plant.—*November 26th*, 1931.

FURNACES.

360,827. July 5th, 1930.—INDUCTION FURNACES, *Arthur Carpmael, of 24, Southampton-buildings, London, W.C. 2.*

It has previously been proposed to construct an inductance furnace with its muffle forming a closed electrical circuit and



constituting the secondary winding of a transformer, the primary winding of which is fed from the supply. The present invention applies to this type of furnace for the purpose of temperature control and utilises the phenomenon of disappear-

ance and reappearance of the magnetism at a critical temperature. It is known that the critical temperature varies with different materials and that some materials are irreversible; that is, the reappearance of ferro-magnetism on cooling takes place at a substantially lower temperature than its disappearance on heating. Use is made of these facts to provide for the desired temperature by suitably selecting the material for the muffle. When, owing to the increase of temperature, the material loses its magnetic properties, the quantity of heat diminishes. At a certain point the quantity of heat is equal to the heat losses of the article or muffle, and from that moment the temperature remains constant and there is no further loss due to magnetism. The muffle A is placed within a primary winding B, from which it is separated by heat-insulating packing C of moderate thickness in order to obtain as good a power factor consistent with the necessary magnetic leakage, and the whole is enclosed by a refractory lid D. The winding B, formed of strip on edge with mica between the turns, is traversed by A.C. from the source E, passages being provided for a cooling fluid. The articles or materials to be heated are placed in the position F.—*November 5th*, 1931.

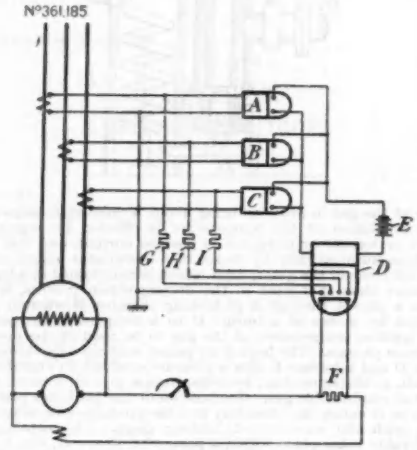
MISCELLANEOUS.

359,982. July 30th, 1930.—MERCURY ARC RECTIFIERS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and John Carley Read, of 14, Dunchurch-road, Rugby.

It is usual to provide mercury arc rectifiers with an ignition anode for starting, which is pulled down into the mercury cathode by means of a solenoid, and returned by a spring when the solenoid is de-energised. The plunger of the solenoid is naturally inside the vacuum chamber, but the coil has to be outside. The invention relates to an improved form of ignition solenoid for use in such rectifiers, and has for its object the provision of an ignition solenoid which will be particularly suitable for rectifiers of large output and for operation of the coil on alternating current. According to a usual form of construction, the plunger slides in a metal tube which communicates at the bottom with the vacuum chamber and is closed at the top, and the coil is carried on the outside of this tube. In order that the tube may not short circuit the solenoid magnetically and may not shield the plunger by circulating currents in it when the solenoid is operating on alternating current the tube is, according to the invention, constructed of a chromium nickel steel alloy commonly known under the registered trade mark "Staybrite," a non-magnetic metal having high electrical resistivity and which is not affected by mercury. Compared with previous constructions in which the tube has been made of porcelain, this construction has the advantages that the coil can be situated close to the plunger so that the operating kVA required for a given force is greatly reduced; and further, the reliability is improved owing to the fact that the plunger slides inside a smooth metal surface.—*October 30th*, 1931.

361,185. January 19th, 1931.—PROTECTIVE APPARATUS FOR ELECTRICAL SUPPLY NETWORKS, Siemens-Schuckertwerke Aktiengesellschaft, Berlin-Siemensstadt, Germany.

According to this invention, when overload relays operate, the voltage of the network and the sensitiveness of the overload relays are reduced. On one or more of the overload relays A, B, C operating, the auxiliary relay D is connected to an auxiliary source of supply E, and the previously short-circuited resistance F is connected in the exciting circuit of the exciter. After this resistance has been inserted, which causes partial de-excitation, the upper contacts are closed by the auxiliary relay D, thus connecting the resistances G, H and I in parallel with the overload relays. The sensitiveness of the latter is thereby reduced, so that they again tend to reopen their contacts. If the current is still too great, their contacts remain closed and the resistance F remains inserted in the exciting circuit.



If the excess current has been reduced by de-excitation to such an extent that the overload relays again open their contacts, the armature of the auxiliary relay is released, the parallel resistances G, H and I are disconnected and the resistance F is again short-circuited. The original sensitiveness of the overload relays is then restored and that relay which is carrying the greatest excess current again operates as soon as the current in this phase has again risen to the value for operating the overload relay in question, whereupon the cycle begins afresh. A momentary opening and closing of the short circuit across the resistance F is thus obtained, and the short-circuit current is regulated to a value fluctuating between fixed limits, which may be as close as desired, by suitably adjusting the overload relays. The invention therefore permits the current to be kept within limits as close as desired, quite irrespective of how far the current intensity must fall in order to cause the overload relay to be released again.—*November 19th*, 1931.

361,727. February 3rd, 1931.—A PROCESS OF MAKING ALLOYS WHICH ARE PARTICULARLY SUITABLE FOR THE PRODUCTION OF METAL FITTINGS WHICH COME INTO CONTACT WITH SUPERHEATED STEAM, Berndorfer Metallwarenfabrik Arthur Krupp Aktiengesellschaft, of Berndorf, Lower Austria.

This invention relates to a process of making alloys which are particularly suitable for the production of metal fittings which come into contact with superheated steam, especially for valves and the like. Such alloys must fulfil the condition of complete insensitiveness to the action of superheated steam, even at very high temperatures. Moreover, they must be capable of being cast, forged and worked by cutting tools. Combining these different properties in one alloy therefore entails difficulties, since those metals which impart one property to the alloy detract from its qualities in another respect. Thus, the addition of tin and nickel, which would increase the resistance to corrosion, impair the forging qualities. Conversely, metals, such as, for example, iron and manganese, the addition of which to the alloy render it capable of being forged, are known to have a low resistance to corrosion. It has now been ascertained that an alloy complying with all the foregoing requirements, consists mainly of copper, together with about 2 per cent. of iron and from 2 to 4·5 per cent. of silicon. In accordance with the present invention, such alloys are produced in a commercially economic manner by alloying the copper with such amount of ferro-silicon that the whole of the required amount of silicon and a part of the required amount of iron is introduced into the alloy by means of said ferro-silicon. The alloys to be produced by the process of the present invention need not have a high resistance to various corrosive influences. On the other hand, however, they do not require any cumbersome improving process and have a good capability of being shaped in a cold state whilst not being too soft. Moreover, the alloys, in accordance with the present invention, are distinguished by an extremely high coefficient of elasticity which facilitates their employment not only for annular seatings for superheated steam valves, but also for valve diaphragms and also for springs of all kinds.—*November 26th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

ILLUMINATING ENGINEERING SOCIETY.—At the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. "Motor Car Headlights," by Mr. E. S. Calvert. Discussion 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, St. James's Park, London, S.W. 1. Thomas Lowe Gray Lecture. "Modern Types of Propelling Machinery for Mercantile Marine Use," by Mr. Sterry B. Freeman. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Refrigeration: Modern Practice and Practical Calculations," by Mr. B. C. Oldham. 7.30 p.m.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. "Ships' Electric Deck Auxiliaries," by Mr. A. Read. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—The Engineers' Club, Albert-square, Manchester. "Recent Developments in the Manufacture of Welded Structures," by Mr. L. Miller. 7.15 p.m.

RAILWAY CLUB.—57, Fetter-lane, E.C. 4. "Further Problems of Passenger Train Operation," by Mr. C. R. Clinker. 7.30 p.m.

TO-DAY TO SATURDAY, JANUARY 23RD.

MODELS EXHIBITION AND PAGEANT OF POSTAGE STAMPS.—Dorland Hall, London, S.W. 1. 10.30 a.m. daily.

SATURDAY, JANUARY 9TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Christmas Lecture, "The Universe of Light, Lecture VI., Light from the Sun and the Stars," by Sir William Bragg, F.R.S. 3 p.m.

MONDAY, JANUARY 11TH.

CHARTERED SURVEYORS' INSTITUTION.—12, Great George-street, Westminster, S.W. 1. "The Genius of Wren," by Mr. P. W. Lovell. 8 p.m.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Some Properties of Fire-bricks," by Mr. H. C. Biggs. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Victoria Embankment, W.C. 2. Informal meeting. Correction of title to discussion. "The Relative Importance of Current and Installation Costs as Affecting the Sale of Electricity," opened by Mr. H. T. Young.

TUESDAY, JANUARY 12TH.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Discussion. "An Experimental Determination of the Distribution and Thickness of the Oil Film in a Flooded Cylindrical Bearing" (Part II.), by Mr. J. Goodman; "The Stability of Lubricating Films in Journal Bearings," by Dr. H. W. Swift. 6 p.m.

INSTITUTE OF MARINE ENGINEERS.—The Minories, London E.C. 3. "Bilge Pumping in its Relation to Safety at Sea," by Mr. E. F. Spanner. 6 p.m.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "Stainless Steel," by Mr. J. H. G. Monypenny. 7 p.m.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Discussion on "Defects in Non-ferrous Castings," by Messrs. R. Dowson, S. G. Homfray and A. Logan. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Graduates' Meeting, Watergate House, Adelphi, W.C. 2. "Carburisation," by Mr. E. W. Knott. 7.25 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "A Review of the Piston and Cylinder Assembly in Relation to Oil Consumption," by Mr. E. C. Ottaway. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Hotel Metropole, Leeds. "Two Transmission Line Problems," by Mr. P. J. Ryle. 7 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. "Modern Methods of Steel Bridge Manufacture," by Mr. J. Thomson. 7.30 p.m.

INSTITUTION OF PETROLEUM TECHNOLOGISTS.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "The Chemistry of the Conversion of Algæ into Bitumen and Petroleum and of the Fucosite-Petroleum Cycle," by Mr. J. E. Hackford. 5.30 p.m.

TUESDAY AND WEDNESDAY, JANUARY 12TH AND 13TH.

FARADAY SOCIETY.—In the Lecture Theatre, Bio-chemical Laboratory, Oxford. General discussion. "The Adsorption of Gases." General introduction by Professor H. S. Taylor. Tuesday, 2.30 p.m. to 6.30 p.m.; Wednesday, 9.30 a.m. to 1 p.m., 2.30 p.m. to 4.30 p.m.

THURSDAY, JANUARY 14TH.

INSTITUTE OF MARINE ENGINEERS: JUNIOR SECTION.—The Minories, London, E.C. 3. "The Care and Maintenance of Marine Diesel Engines," by Eng.-Lieut.-Comr. H. S. Humphreys, R.N. (retd.). 7 p.m.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—In the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. "X-Ray Examination of Alloys," by Mr. G. D. Preston. 7.30 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—In the Chamber of Commerce, Birmingham. Vernon Harcourt Lecture, "The Mechanical Handling of Coal at Ports," by Mr. N. G. Gedye, 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: YORKSHIRE BRANCH. Hotel Metropole, Leeds. Annual General Meeting. "Recent Developments in the Treatment of Boiler Water," by Dr. A. W. Chapman. 7.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W. 1. "Creep Properties of Metals," by Mr. H. J. Tapsell. 6.30 p.m.

ROYAL AERONAUTICAL SOCIETY.—In the Lecture Theatre, Royal Society of Arts, John-street, Adelphi, W.C. 2. "Interference," by Mr. E. Ower. 6.30 p.m.

FRIDAY, JANUARY 15TH.

CHEMICAL ENGINEERING GROUP.—In the Rooms of the Chemical Society, Burlington House, Piccadilly, London, W. 1. "The Preparation of Emulsions," by Dr. William Clayton. 8 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. "Stresses in Metals," by Mr. A. Wragg. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's Gate, St. James's Park, S.W. 1. Informal Meeting. Discussion on "Industrial Conditions in Russia," introduced by Mr. J. Fearn. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Development of the Loud Speaker," by Mr. H. J. N. Riddle. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Lecture Theatre of the Mining Institute, Newcastle-on-Tyne. "Rivets and their Significance in Shipbuilding," by Mr. Robert Boardman. 6 p.m.

SATURDAY, JANUARY 16TH.

HULL ASSOCIATION OF ENGINEERS.—Municipal Technical College, Park-street, Hull. "The Application of Gearing," by Mr. H. E. Merritt. 7.15 p.m.

MONDAY, JANUARY 18TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Epicyclic Gearing," by Major W. G. Wilson. 7.30 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. Thomas Gray Lecture, "Life Saving Appliances on Merchant Ships" (Lecture I.), by Captain O. A. Barrand and Mr. G. A. Green. 8 p.m.

TUESDAY, JANUARY 19TH.

INSTITUTE OF INDUSTRIAL ADMINISTRATION.—Lecture Hall Institute of Hygiene, 28, Portland-place, London, W. 1. "Some Problems of Industrial Administration and Accounting," by Mr. Thomas Keens. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineering Club, Queen-street, Wolverhampton. "A Review of the Piston and Cylinder Assembly in Relation to Oil Consumption," by Mr. E. C. Ottaway. 7.30 p.m.

OLD CENTRALIANS.—The Devereux, Devereux-court, W.C. 2. Luncheon. Speaker, Professor Bone, on "Low-temperature Carbonisation." 1 p.m.

WEDNESDAY, JANUARY 20TH.

INSTITUTION OF LOCOMOTIVE ENGINEERS: BIRMINGHAM CENTRE.—Room 178, Queen's Hotel, Birmingham. "Roads and the Road Roller," by Mr. C. G. Miller. 6.45 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Some Aspects of the Problem of Industrial and Commercial Waste," by Mr. J. L. Hodgson. 8 p.m.

THURSDAY, JANUARY 21ST.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "Electric Welding of Non-ferrous Alloys," by Dr. A. Burstall. 7 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS.—Hotel Metropole, Leeds. "The Employment of Structural Engineers as Specialists," by Mr. W. T. Creswell. 7 p.m.

INSTITUTION OF WELDING ENGINEERS.—At the Institution of Mechanical Engineers, Storey's-gate, St. James's Park, London, S.W. 1. "Nickel and its Non-ferrous Alloys, with Special Reference to Welding," by Mr. J. McNeil. 7.45 p.m.

FRIDAY, JANUARY 22ND.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Hotel Metropole, Leeds. "Progressive Methods Applied to a Modern Shop for Electric Rolling Stock," by Colonel E. Graham. 7.15 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. Lecture, "Notes on Hydraulic Installations in New Zealand," by Mr. H. S. Lamburd. 7.30 p.m.

MONDAY, JANUARY 25TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. Thomas Gray Lecture, "Life Saving Appliances on Merchant Ships" (Lecture II.), by Captain O. A. Barrand and Mr. G. A. Green. 8 p.m.

TUESDAY, JANUARY 26TH.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Empire Timbers," by Major J. R. Cosgrave. 4.30 p.m.

WEDNESDAY, JANUARY 27TH.

BRITISH WOOD PRESERVING ASSOCIATION.—In the Lecture Hall, Auctioneers' and Estate Agents' Institute, 29, Lincoln's Inn-fields, London, W.C. 2. "Diseases of Timber," by Mr. K. St. G. Cartwright. 6 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Metropole Hotel, King-street, Leeds. "A Review of the Piston and Cylinder Assembly in Relation to Oil Consumption," by Mr. E. C. Ottaway. 7.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineers' Club, Manchester. "Transmission," by Mr. L. H. Pomeroy. 7 p.m.

FRIDAY, JANUARY 29TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Centrifugal Separation of Liquids—Industrial Applications to Oils and other Fluids," by Mr. J. J. Haslam. 7.30 p.m.

MONDAY, FEBRUARY 1ST.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2. "Life Saving Appliances on Merchant Ships" (Lecture III.), by Captain A. O. Barrand and Mr. G. A. Green. 8 p.m.

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